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COMPARATIVE STUDY OF AIR CLASSIFIERS

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16. ABSTRACT

This report describes the results of field tests of seven different air classifier systems. The systems are compared in regard to (a) their capacity to handle refuse and separate it into a heavy fraction and a light fuel fraction, (b) their ability to concentrate lights in the light fraction and heavies in the heavies fraction as compared to the infeed, (c) the quality of the light fraction for refuse-derived fuel, (d) the yield of combustibles from the infeed that are collected in the light fraction, (e) the consumption of air required to handle a given quantity of infeed, and (f) costs (engineering, capital, and operation and maintenance) per unit weight of refuse infeed at design capacity. Tests were run on each classifier at three airflow rates and at 5 to 10 refuse infeed rates. Procedures used to run these tests are given, and treatment of samples taken from light and heavy fraction streams is outlined. Each air classifier system is described, operation explained, and conclusions and recommendations enumerated.

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FOREWORD

The U.S. Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and welfare of the American people. Noxious air, foul water, and spoiled land are tragic testimonies to the deterioration of our natural environment. The complexity of that environment and the interplay of its components require a concentrated and integrated attack on the problem.

Research and development is that necessary first step in problem solution; it involves defining the problem, measuring its impact, and searching for solutions. The Municipal Environmental Research Laboratory develops new and improved technology and systems to prevent, treat, and manage wastewater and solid and hazardous waste pollutant discharges from municipal and community sources, to preserve and treat public drinking water supplies, and to minimize the adverse economic, social, health, and aesthetic effects of pollution. This publication is one of the products of that research and provides a most vital communications link between the researcher and the user community.

The disposal of solid waste through resource recovery of both recyclable material and fuels is of concern to the Municipal Environmental Research Laboratory. This project deals with a vital segment of resource recovery systems. Performance, operating experience, and economics are compared for a number of competing air classifier designs.

Francis T. Mayo, Director
Municipal Environmental Research
Laboratory

PREFACE

A number of systems have been assembled to recover fuel and other resources from solid waste, and many more are expected to be assembled in the future. Components to separate combustible fuel, metals, and glass from the incoming stream of solid waste are integral parts of the overall system. Air classifiers are widely used to effect separation of light materials from the heavy materials. Several designs of air classifiers have been developed, but few data are available that would permit the performance of one design to be compared with that of another. The work undertaken is directed toward collecting data and other information that would facilitate comparing selected air classifiers on the basis of economics and performance.

The team of Midwest Research Institute and Cal Recovery Systems, Inc., has tested seven different air classifiers and collected design, operational, and economic data for each. The tests were conducted over a range of airflow rates and solid waste feed rates. Samples were withdrawn from the lights and heavies streams to determine the lights and heavies split and for subsequent analysis of constituents that make up each stream. In addition, the electrical power required to operate the air classifier part of the resource recovery plant was measured. Analysis of the collected data will provide insight into the optimum range for operating each air classifier, effects of overfeeding, plant capital and operating costs, reliability of operation, energy consumption, and the fuel and metal recovered from the solid waste processed. The material presented here is expected to be of value to designers, purchasers, and operators of resource recovery systems.

ABSTRACT

Seven air classifier systems used in refuse plants have been evaluated on the basis of environmental benefits, economics, and performance. The seven test locations were:

	Air classifier	
Location	Size category	Type
Akron	Large	Vibrating fluidized bed
Ames	Large	Vertical rectangular
Baltimore	Large	Vertical round with dispersion cone
Tacoma	Large	Horizontal
Los Angeles	Small	Dual vortex
Pompano Beach	Small	Vibrating fluidized bed
Richmond	Small	Vertical rectangular

The small-category air classifiers had design capacities of 4 to 6 Mg/h, and the large air classifier design capacities were 45 to 73 Mg/h.

The systems are compared with regard to (a) their capacity to handle refuse and separate it into heavy and light fuel fractions, (b) their ability to concentrate lights in the light fraction and heavies in the heavies fraction as compared with the infeed, (c) the quality of the light fraction for refuse-derived fuel (RDF), (d) the yield of combustibles from the infeed that are collected in the light fraction, (e) the consumption of air required to handle a given quantity of infeed, and (f) costs (engineering, capital, and operation and maintenance) per unit weight of refuse infeed at design capacity.

This report was submitted in fulfillment of Contract No. 68-03-2730 by Midwest Research Institute under the sponsorship of the U.S. Environmental Protection Agency. This report covers the period August 14, 1978 to November 28, 1980, and work was completed as of November 28, 1980.

CONTENTS

Page

Foreword iii
Preface iv
Abstract v
Figures viii
Tables xi
Acknowledgments xiv

1. Introduction 1
2. Conclusions and Recommendations 3
    Conclusions 3
    Recommendations 4
3. Evaluation Methodology 5
    Collection of design, operation, and economic information 5
    Field testing 6
    Data analysis 12
    Air classifier comparisons 15
4. Results of Air Classifiers Evaluated 17
    Horizontal air classifier--Tacoma, Washington 17
    Vertical cylindrical air classifier with dispersion cone--Baltimore County, Maryland 38
    Vertical rectangular air classifier--Richmond, California 57
    Modified vertical rectangular air classifier--Ames, Iowa 72
    Dual vortex air classifier--Los Angeles, California . . . 91
    Vibrating fluidized bed air classifier--Akron, Ohio . . . 106
    Vibrating fluidized bed air classifier--Pompano Beach, Florida 126
5. Comparison of Air Classifiers 147
    Environmental comparisons 147
    Operations 148
    Criteria for energy recovery and performance comparisons 148
    Energy recovery 149
    Performance and economics 151

References 164

CONTENTS (concluded)

Page

Appendices

A. Field test forms 166
B. Field test data for horizontal air classifier--Tacoma, Washington 174
C. Field test data for vertical cylindrical air classifier with dispersion cone--Baltimore County, Maryland. 188
D. Field test data for vertical rectangular air classifier--Richmond, California 203
E. Field test data for modified vertical rectangular air classifier--Ames, Iowa 216
F. Field test data for dual vortex air classifier--Los Angeles, California. 232
G. Field test data for vibrating fluidized bed air classifier--Akron, Ohio. 247
H. Field test data for vibrating fluidized bed air classifier--Pompano Beach, Florida 262

List of Terms, Abbreviations, and Symbols 277

FIGURES

Number		Page
1	Basic air classifier system	7
2	Data for determining traverse points	10
3	Municipal solid waste system flow diagram - Tacoma, Washington	18
4	Plant processing line - Tacoma, Washington	19
5	Air classifier system - Tacoma, Washington	21
6	Air classifier - Tacoma, Washington	22
7	Air classifier airflow diagram - Tacoma, Washington	23
8	Duct traverse points for pitot tube - Tacoma, Washington	27
9	Lights production rate as a function of infeed rate - Tacoma, Washington	29
10	Light fraction combustibles versus infeed rate - Tacoma, Washington	31
11	Refuse-derived fuel yield versus infeed rate - Tacoma, Washington	32
12	Percentage paper and plastic in heavies versus solids to air weight ratio - Tacoma, Washington	33
13	Percentage ash retained in lights versus solids to air weight ratio - Tacoma, Washington	35
14	Percentage of infeed reporting to lights versus solids to air weight ratio - Tacoma, Washington	36
15	Energy recovery versus infeed rate - Tacoma, Washington	37
16	Municipal solid waste system flow diagram - Baltimore County, Maryland	39
17	Diverter blade system - Baltimore County, Maryland	40
18	Air classifier system - Baltimore County, Maryland	41
19	Air classifier details - Baltimore County, Maryland	43
20	Air classifier airflow diagram - Baltimore County, Maryland	44
21	Lights production rate as a function of infeed rate - Baltimore, Maryland	49
22	Light fraction combustibles versus infeed rate - Baltimore, Maryland	50
23	Refuse-derived fuel yield versus infeed rate - Baltimore, Maryland	51
24	Percentage of paper and plastic in heavies versus solids to air weight ratio - Baltimore, Maryland	53
25	Percentage of ash retained in lights versus solids to air weight ratio - Baltimore, Maryland	54

FIGURES (continued)

Number		Page
26	Percentage of infeed reporting to lights versus solids to air weight ratio - Baltimore, Maryland.	55
27	Energy recovery versus infeed rate - Baltimore, Maryland. .	56
28	MSW system flow diagram - Richmond, California.	58
29	Air classifier system - Richmond, California.	59
30	Lights production rate as a function of infeed rate - Richmond, California.	63
31	Light fraction combustibles versus infeed rate - Richmond, California.	65
32	Refuse-derived fuel yield versus infeed rate - Richmond, California.	66
33	Percentage of paper and plastic in heavies versus solids to air weight ratio - Richmond, California.	67
34	Percentage of ash retained in lights versus solids to air weight ratio - Richmond, California	69
35	Percentage of infeed reporting to lights versus solids to air weight ratio - Richmond, California	70
36	Energy recovery versus infeed rate - Richmond, California .	71
37	Flow diagram of solid waste processing plant - Ames, Iowa .	73
38	Front half of air classifier - Ames, Iowa	75
39	Back half of air classifier - Ames, Iowa.	76
40	Air separation chamber - Ames, Iowa	77
41	Lights production rate as a function of infeed rate - Ames, Iowa.	83
42	Percentage of paper and plastic in lights versus solids to air weight ratio - Ames, Iowa	86
43	Percentage of ash from lights versus solids to air weight ratio - Ames, Iowa.	88
44	Percentage of lights versus solids to air weight ratio - Ames, Iowa.	89
45	Energy recovery versus infeed rate - Ames, Iowa	90
46	Flow diagram of experimental refuse processing plant - Los Angeles, California	92
47	Air classifier - Los Angeles, California.	93
48	Lights production rate as a function of infeed rate - Los Angeles, California	98
49	Percentage of paper and plastic in heavies versus solids to air weight ratio - Los Angeles, California	101
50	Percentage of ash from lights versus solids to air weight ratio - Los Angeles, California	102
51	Percentage of lights produced versus solids to air weight ratio - Los Angeles, California	103
52	Energy recovery versus infeed rate - Los Angeles, California.	105
53	Schematic diagram of municipal solid waste processing portion of the Akron, Ohio, resource recovery facility. .	107

FIGURES (concluded)

Number Page

54 Material flow diagram - Akron, Ohio 108
55 Vibrating fluidized bed air classifier - Akron, Ohio. . . . 109
56 Airflow diagram - Akron, Ohio 111
57 Lights production rate as a function of infeed rate - Akron, Ohio 116
58 Percentage combustibles in light fraction - Akron, Ohio . . 119
59 Refuse-derived fuel yield as a function of infeed rate - Akron, Ohio 120
60 Percentage paper and plastic in the heavies versus solids to air ratio - Akron, Ohio. 121
61 Percentage of ash from lights versus solids to airflow weight ratio - Akron, Ohio. 123
62 Percentage of infeed reporting to lights versus solids to air weight ratio - Akron, Ohio. 124
63 Energy recovery versus infeed rate - Akron, Ohio. 125
64 Material flow diagram for overall RefCOM facility - Pompano Beach, Florida. 127
65 Vibrating fluidized bed air classifier - Pompano Beach, Florida 128
66 Airflow schematic for Pompano Beach, Florida, air classifier. 130
67 Lights production rate as a function of infeed rate - Pompano Beach, Florida. 137
68 Light fraction combustibles versus infeed rate - Pompano Beach, Florida. 139
69 Refuse-derived fuel yield versus infeed rate - Pompano Beach, Florida. 141
70 Percentage of paper and plastic in heavies versus solids to air weight ratio - Pompano Beach, Florida. 142
71 Percentage of ash from lights versus solids to air weight ratio - Pompano Beach, Florida. 143
72 Percentage lights separated from infeed versus solids to air weight ratio - Pompano Beach, Florida 145
73 Energy recovery versus infeed rate - Pompano Beach, Florida 146

TABLES

Number		Page
1	Data Flow	8
2	Concentration Factors for Horizontal Air Classifier - Tacoma, Washington	28
3	Concentration Factors for Vertical Cylindrical Air Classifier with Dispersion Cone - Baltimore, Maryland	47
4	Estimated Costs for Vertical Rectangular Air Classifier - Richmond, California	60
5	Concentration Factors for Vertical Rectangular Air Classifier - Richmond, California	62
6	Air Classifier Downtime, 1977 - Ames, Iowa	78
7	Concentration Factors for a Modified Vertical Rectangular Air Classifier - Ames, Iowa	81
8	Specific Energy Consumption - Ames, Iowa	84
9	Light Fraction Combustibles for a Modified Vertical Rectangular Air Classifier - Ames, Iowa	85
10	Refuse-Derived Fuel Yield for a Modified Vertical Rectangular Air Classifier - Ames, Iowa	85
11	Estimated Costs for Dual Vortex Air Classifier - Los Angeles, California	94
12	Concentration Factors for Dual Vortex Air Classifier - Los Angeles, California	96
13	Specific Energy Consumption - Los Angeles, California	99
14	Light Fraction Combustibles Using a Dual Vortex Air Classifier - Los Angeles, California	99
15	Refuse-Derived Fuel Yield Using a Dual Vortex Air Classifier - Los Angeles, California	100
16	Summary of Airflows for Vibrating Fluidized Bed Air Classifier - Akron, Ohio	113
17	Concentration Factors Vibrating Fluidized Bed Classifier - Akron, Ohio	114
18	Specific Energy Consumption - Akron, Ohio	117
19	Light Fraction Combustibles Using a Vibrating Fluidized Bed Air Classifier - Akron, Ohio	118
20	Refuse-Derived Fuel Yield Using a Vibrating Fluidized Bed Air Classifier - Akron, Ohio	118
21	Typical Analysis of Shredded Municipal Solid Waste - Pompano Beach, Florida, Design Specifications	131
22	Summary of Airflow Through Air Classifier System - Pompano Beach, Florida	134

TABLES (continued)

Number Page

23 Concentration Factors for Vibrating Fluidized Bed Air Classifier - Pompano Beach, Florida 135
24 Specific Energy Consumption - Pompano Beach, Florida. . . . 138
25 Light Fraction Combustibles Using a Vibrating Fluidized Bed Air Classifier - Pompano Beach, Florida 138
26 Refuse-Derived Fuel Yield Using a Vibrating Fluidized Bed Air Classifier - Pompano Beach, Florida 140
27 Average Values of Heating Values at Operating Conditions ≧ Critical Air Solids Ratios. 150
28 Average Material Characteristics for ≧ Critical Air Solids Ratios 152
29 Summary of Operating Parameters of Air Classifiers Tested . 153
30 Summary of Operating and Performance Characterization of Air Classifier Systems Tested 154
31 Values of Ratio of Percent Energy Recovered$_{LTS}$ to Percent Ash Retained$_{LTS}$ for ≧ Critical A/S Ratio. 156
32 Values of the Ratio of Energy Recovered to Retained Ash for ≧ Critical A/S Ratio for Ames, Iowa 157
33 Summary of the Ratio of Average Recovered Energy to Average Retained Ash for Each Air Classifier and Air Setting 158
34 Air Classifier Performance Parameters for Refuse-Derived Fuel Recovery 159
35 Air Classifier Cost Summary 160
36 Operating and Performance for Refuse-Derived Fuel Recovery of the Seven Air Classifiers Tested 162
37 Comparison of Infeed Rates. 163
B-1 Summary of Operational Data--Tacoma 174
B-2 Feed Rates--Tacoma. 175
B-3 Airflow, Lowest--Tacoma 176
B-4 Airflow, Middle--Tacoma 177
B-5 Airflow, Highest--Tacoma. 178
B-6 Particle Size Distribution--Tacoma. 179
B-7 Sample Composition--Tacoma. 182
B-8 Moisture Content, Initial to Air Dried Condition--Tacoma. . 186
B-9 Power Measurements--Tacoma. 187
C-1 Summary of Operational Data--Baltimore. 188
C-2 Feed Rates--Baltimore 189
C-3 Airflow, Lowest--Baltimore. 190
C-4 Airflow, Middle--Baltimore. 191
C-5 Airflow, Highest--Baltimore 192
C-6 Particle Size Distribution--Baltimore 193
C-7 Sample Composition--Baltimore 197
C-8 Moisture Content, Initial to Air Dried Condition--Baltimore 201
C-9 Power Measurements--Baltimore 202

TABLES (concluded)

Number Page

D-1 Summary of Operational Data--Richmond 203
D-2 Feed Rates--Richmond 204
D-3 Airflow, Lowest--Richmond 205
D-4 Airflow, Middle--Richmond 206
D-5 Airflow, Highest--Richmond 207
D-6 Particle Size Distribution--Richmond 208
D-7 Sample Composition--Richmond 210
D-8 Moisture Content, Initial to Air Dried Condition--Richmond 214
D-9 Power Measurements--Richmond 215
E-1 Summary of Operational Data--Ames 216
E-2 Feed Rates--Ames 217
E-3 Airflow, Lowest Rate Setting--Ames 218
E-4 Airflow, Middle Rate Setting--Ames 219
E-5 Airflow, Highest Rate Setting--Ames 220
E-6 Particle Size Distribution--Ames 221
E-7 Sample Composition--Ames 225
E-8 Moisture Content, Initial to Air Dried Condition--Ames 230
E-9 Power Measurements, August 1979--Ames 231
F-1 Summary of Operational Data--Los Angeles 232
F-2 Feed Rates--Los Angeles 233
F-3 Lowest Airflow--Los Angeles 234
F-4 Middle Airflow--Los Angeles 235
F-5 Highest Airflow--Los Angeles 236
F-6 Particle Size Distribution--Los Angeles 237
F-7 Sample Composition--Los Angeles 241
F-8 Moisture Content, Initial to Air Dried Condition--Los Angeles 245
F-9 Power Measurements--Los Angeles 246
G-1 Summary of Operational Data--Akron 247
G-2 Feed Rates--Akron 248
G-3 Airflow, Lowest--Akron 249
G-4 Airflow, Middle--Akron 250
G-5 Airflow, Highest--Akron 251
G-6 Particle Size Distribution--Akron 252
G-7 Sample Composition--Akron 256
G-8 Moisture Content, Initial to Dried Condition--Akron 260
G-9 Power Measurements--Akron 261
H-1 Summary of Operational Data--Pompano Beach 262
H-2 Feed Rates--Pompano Beach 263
H-3 Lowest Airflow--Pompano Beach 264
H-4 Middle Airflow--Pompano Beach 265
H-5 Highest Airflow--Pompano Beach 266
H-6 Particle Size Distribution--Pompano Beach 267
H-7 Sample Composition--Pompano Beach 271
H-8 Moisture Content, Initial to Air Dry--Pompano Beach 275
H-9 Power Requirements--Pompano Beach 276

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SECTION 1

INTRODUCTION

The disposal of vast quantities of solid waste has long been a problem confronting our urban and suburban areas. In regions where large areas of unused land are available, raw refuse is dumped as landfill. In many communities available landfill areas are rapidly being depleted. However, municipal refuse can also be considered a resource instead of a problem. Since refuse is largely composed of combustible materials, valuable energy may be recovered. As the high cost and low availability of fossil fuels become more acute, resource recovery and applications for using refuse as fuel will become more attractive.

A number of uses for plastic and paper reclaimed from municipal solid waste (MSW) have been proposed, including refuse-derived fuel (RDF), densified RDF (d-RDF), nutrients for methane digestant, and stock for cellulose insulation and paper and cardboard products. Before reclaimed paper and plastic can be used to make paper products, however, a number of questions involving potential health problems from contaminants need to be resolved. These problems are beyond the scope of the work reported here.

At present, contamination-free stocks are obtained from source separation programs such as paper collection drives and cardboard recycling activities.[1] Nutrients for methane digesters are plagued by fibrous materials, inert constituents, and unwanted chemical reactions involving metals and other trace chemicals. The unique requirements for methane digesters dictate system development beyond trommel separation and air classification. However, in a number of boiler systems all air-classified paper and plastic material is suitable for use as fuel. In view of the above, this report considers air classification only for RDF and d-RDF uses.

The U.S. Environmental Protection Agency (EPA) recognizes the benefits of reducing pollution by the extraction of fuel and recyclable metals and glass from refuse and it has been instrumental in the development of resource recovery plants. Early attempts at producing a refuse-derived fuel did not use air classification to separate the combustibles from the solid waste. These early systems were plagued with jamming and wear problems. But when air classifiers were incorporated into the system, these problems were greatly reduced. Nearly all current resource recovery systems employ an air classifier as an integral component of the system.

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Several different air classifier designs have been developed and installed, but little is known about their performance. Engineering comparisons between competing classifier designs have not been made. Since it is anticipated that many more resource recovery plants will be designed and constructed in the future, a comparative evaluation of air classifier designs is desirable.

Realizing the need for such a comparision, EPA has sponsored this study to evaluate seven air classifiers. The final results of the work address technical, economic, environmental, and operational aspects of each system.

The following sections of this report (a) describe the air classifiers evaluated, (b) outline the general evaluation plan followed, (c) present the results of each evaluation, (d) compare the performance of the air classifiers evaluated, (e) recommend additional evaluation, and (f) contain supporting field data.

SECTION 2

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

- Under proper operating conditions, air classifiers separate shredded solid waste into a light, mainly combustible fraction and a heavy, mainly noncombustible fraction.

- Under typical plant operating conditions, an air classifier will recover in the light fraction 73 to 99% of the energy present in the MSW feedstock.

- A minimum value (approximately two) of the air/solids ratio exists in which there is insufficient dilution of the refuse material to effect efficient separation of the combustible and noncombustible particles.

- The carryover of noncombustible fine material (e.g., dirt and glass fines) is a generic problem noted in all the air classifiers tested.

- The quality (percent combustibles) of the light fraction is similar for all units tested, and the light fraction should have sufficient heating value for use as a solid fuel.

- Except for one unit, all of the air classifiers that were tested exhibit a "transition zone," or "choking point," after which the rate of light fraction recovery declines with a further increase of the feed rate. The location of the transition zone is important because light fraction splits, and, therefore, properties of the light fraction remain relatively constant for those light fraction feed rates at or below the transition zone.

- The selection and establishment of the operational set point of an air classifier are based on site specific considerations involving, for example, an evaluation of the trade-offs between RDF quality and yield. Other important factors bearing upon air classifier selection and operation include specific energy requirements for operating the air classifier, heating value and ash content of the light fraction, noncombustible materials retained in the light fraction, and combustible material lost in the heavy fraction.

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- The definition of the processing objectives of the air classifier system and the establishment of practical operating limits upon the air classifier will enable an optimum set point to be determined for each air classifier. The evaluation will involve an assessment of trade-offs between operational considerations and quality of the light fraction. The study shows that no air classifier that was tested was found to be superior in all areas of performance and operation.

RECOMMENDATIONS

- Specifications for air classifiers should include ranges of performance which are based on the objective of the air classification process (e.g., RDF, recovery) and utilize the data and performance parameters presented in the report.

- Tests should be conducted to determine an air classifier's performance shortly after equipment installation. Using test procedures described in this report, the transition zone should be determined as well as the noncombustibles in the lights and combustibles in the heavies. In addition, the trade-offs between RDF quality and RDF yield as a function of air classifier operating conditions should be established through air classifier testing.

- For a given airflow setting, the performance of an air classifier is highly dependent on material throughput. Therefore, in selecting and installing an air classifier, consideration should be given to the installation of devices for throughput monitoring (such as refuse depth indicators or belt weighers on conveyor belts) and flow control devices (such as variable speed drives on infeed conveyors).

- None of the air classifers that were tested removed all of the noncombustibles from the light fraction. Therefore, in selecting or designing refuse processing systems for recovery of an RDF having a low ash content, consideration should be given to the use of additional processing equipment, either prior or subsequent to the air classification step, to aid in the removal of noncombustible material.

SECTION 3

EVALUATION METHODOLOGY

Air classifier evaluation is undertaken in the following four steps:

- Design, operation, and economic data are collected for a number of different air classifier designs in actual installations.
- Performance data are collected in the field for selected air classifiers operating in a refuse processing system.
- Data from the field tests are analyzed to evaluate the performance of each air classifier tested.
- Results of the field tests are coupled with other information for comparing one air classifier system to another.

COLLECTION OF DESIGN, OPERATION, AND ECONOMIC INFORMATION

Design information includes air classifier configuration, size, and rating of standard components; rated capacity; and how the unit interconnects with the overall refuse process system. The configuration is obtained by examining design drawings or by physical examination of the air classifier system. In this report, the air classifier configuration is presented by sketches and photographs, and the system operation is described. Sizes and ratings of component parts, such as electric motors and blowers taken from nameplates, are also given. Pictorial and schematic sketches as well as photographs are included to show how the air classifier interconnects with the overall refuse processing system. Material flow through the system is traced to illustrate system operation. To determine problems and unique characteristics of the unit, operators of the systems were questioned about air classifier performance.

Capital cost data for the air classifiers have also been collected. These capital costs, which include installation, are limited to the air classifier proper and those components necessary to interconnect it with the refuse processing plant. Operation and maintenance costs were also available at the Ames, Iowa, facility and this information is reported. Operation and maintenance costs were not available at other locations because plant records were not kept separate for the air classifiers.

Operating experience information was obtained by interviewing plant personnel and through observations made during the field tests. Both positive and negative factors are given.

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FIELD TESTING

An air classifier is a system intended to separate combustibles out of a shredded refuse stream leaving the other constituents in the stream. Most combustibles in municipal solid waste (MSW) are paper and plastic. An air classifier must be able to handle a refuse stream with widely varying composition. Minute-to-minute variation is often seen in the refuse stream, and there is wide daily and seasonal variation. Paper and plastic can range from 50 to 80% of the incoming stream over a short period of time. The large variation in the composition of infeed to the refuse plant and subsequently to the air classifier, as well as the variable feed rate inherent to refuse feed systems, makes it difficult to fine tune an air classifier by adjustment of controls. In most refuse processing plants, unsorted refuse is shredded to a specified particle size satisfactory for subsequent processing. Different shredders behave somewhat differently with regard to what material will pass through the shredder without size reduction, but all tend to pulverize glass and other friable materials. Some shredders will pass large flat pieces of metal, cloth, and relatively large blocks of wood. All classifiers are presented with such materials and are expected to properly sort plastic and paper from the shredded refuse stream.

Field test procedures were established to accommodate the wide variability in refuse material and feed rates presented to the air classifier, taking into account that air classifiers operate on aerodynamic principles. There are four streams of interest: airflow, shredded MSW input, the light (fuel) fraction, and the heavy (rejects) fraction. The light fraction is mostly paper and plastic whereas the heavy fraction is mostly metals and other heavy solids.

Figure 1 illustrates a typical straight vertical separation section of an air classifier system. Air enters the heavies output opening and is pulled up through the air classifier. The light material is carried out the top of the unit in the airstream and dropped out in the cyclone. Heavy material not entrained in the airstream falls through the air classifier onto a heavies output conveyor. Information on these four streams, the air classifier system energy consumption, and a constituent examination of samples taken from both the light and heavy fractions yields the basic field data for evaluating all classifier designs.

A test plan was designed for each unit evaluated to ensure that the data gathered could be reduced through basic principles to parameters which could be directly compared. Table 1 lists the data either gathered in the field or derived from laboratory analysis. The brackets indicate which items combine to produce the basic parameters. These data are as accurate and meaningful as possible within the system constraints and with the least amount of disruption to a facility's operations.

A series of tests was run at each of three airflows in the region of the design or preferred operating level. The infeed rate to the air classifier was run at selected rates. The method of obtaining selected infeed

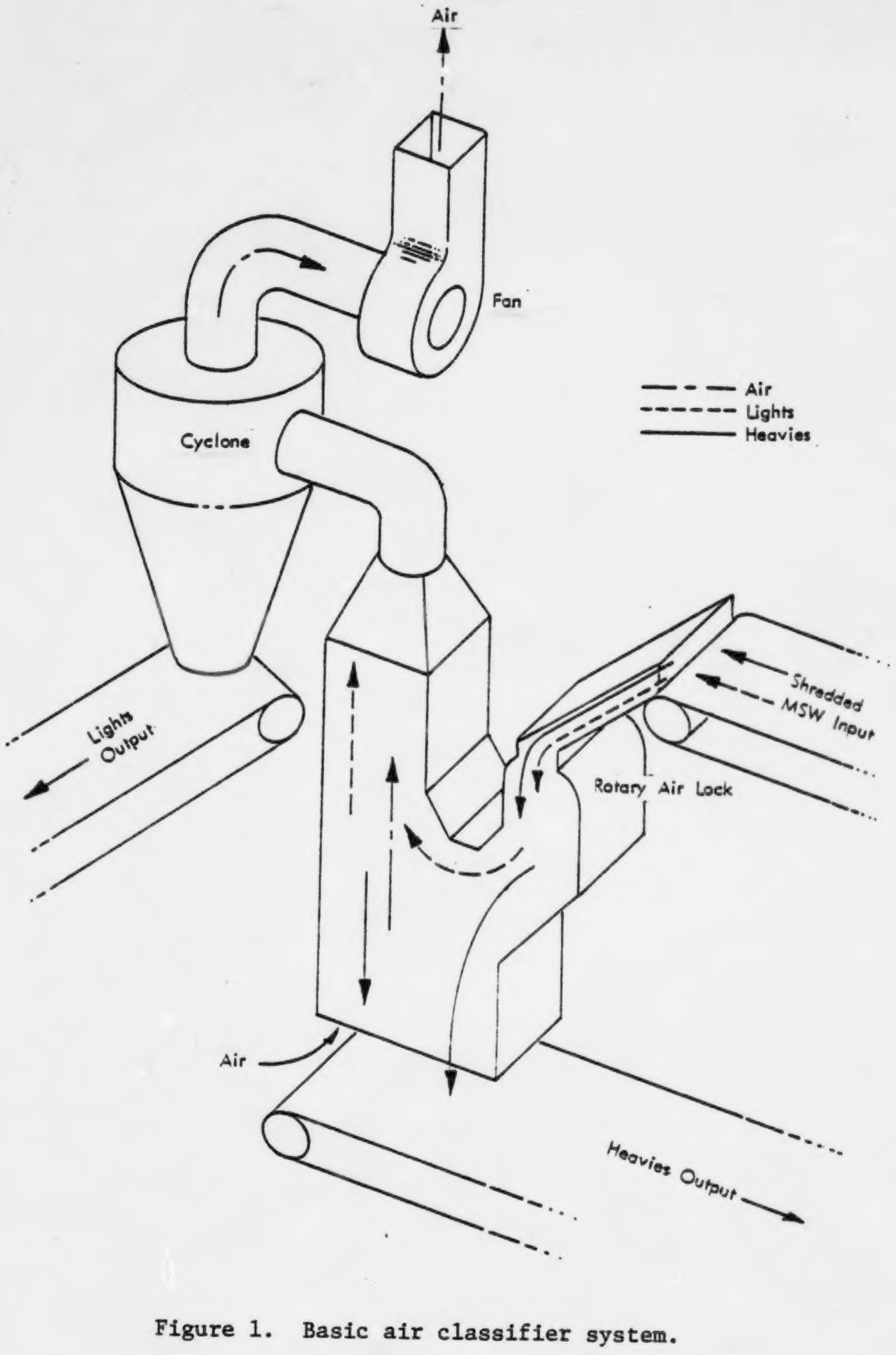
Air
Fan
Air
Lights
Heavies
Cyclone
Shredded MSW Input
Lights Output
Rotary Air Lock
Air
Heavies Output

Figure 1. Basic air classifier system.

TABLE 1. DATA FLOW

Measured quantity			Calculated quantity	
Symbol	Description	Source	Intermediate	Basic parameters
m_{lf}	Mass of light fraction	Lab		
m_{pp-lf}	Mass of paper and plastic in light fraction	Lab		Q_{lf} , combustibles in light fraction
m_{pp-i}	Mass of paper and plastic in input	Lab	Y_R , RDF yield	
m_{a-lf}	Mass of ash from light fraction	Lab		E_o , overall efficiency
m_{a-i}	Mass of ash from input	Lab	Y_s , ash yield	
V	Voltage of energy consumers	Field		
I	Current of energy consumers	Field		kWh , energy consumed per operating hr
ϕ	Phase angle of energy consumers	Field		
V_o	Air velocity (profile/average)	Field		
T_o	Air temperature	Field		
Rh	Relative humidity	Field	m_o , mass flow of air	
A_x	Classifier cross-sectional area	Field		a , air to solids ratio & I/A air loading ratio
m_s	Mass of input sample	Field		
t_{lf}	Time of light fraction sample	Field	m_s , mass flow of input	
V_s	Input belt speed	Field		
m_{hf}	Mass of heavy fraction sample	Field		
t_{hf}	Time of heavy fraction sample	Field	m_{hf} , mass flow of heavies	
V_{hf}	Heavies belt speed	Field		
m_s	Mass of input sample	Field		Split to heavies
t_i	Time of input sample	Field	m_s , mass flow of input	
V_s	Input belt speed	Field		
m_{lf}	Mass of light fraction sample	Field		Split to lights
t_{lf}	Time of light fraction sample	Field	m_{lf} , mass flow of lights	
V_{lf}	Lights belt speed	Field		
ΔP_o	Pressure drop	Field		
	Particle size distribution	Lab		
	Moisture content	Lab		
	Ferrous content	Lab		
	Aluminum content	Lab		

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rates made it difficult to get uniform increments of infeed rates for individual tests. Samples were taken at each infeed rate for each airflow rate. These samples were weighed, bagged in the field, and sent to the laboratory for determination of particle size distribution, moisture content, composition, and ash content. The higher heating values were also determined for the light fraction.

The air velocity was adjusted for each test series. Air velocity determination was based on Environmental Protection Agency (EPA) Methods 1 and 2 published in the Federal Register. This method was used only as a guide due to the turbulent nature of the airflow in an air classifier. Velocity traverse points were established in accordance with the information given in Figure 2. These data were recorded on Forms A-1 and A-2 shown in Appendix A. Wet bulb and dry bulb temperatures of the air entering the air classifier and the barometric pressure were taken as part of the velocity traverse procedure. This information was recorded on Form A-3 (Appendix A).

In evaluating air classifier performance, the energy consumed by the air classifier system is an important parameter. The air classifier system was defined at each facility where tests were made. Energy consumption was determined by measuring the voltage, current, and phase angle and calculating the watts for each prime mover in each classifier system. The fan (blower) energy consumption was determined for each air velocity setting, usually when no refuse was being processed. Energy data were recorded on Form A-4 shown in Appendix A.

The design and layout of each air classifier system was recorded by making sketches and taking photographs. The sketches included dimensions and details helpful in understanding the unit's operation. Form A-5 (shown in Appendix A) was used to record detailed information on the conveying mechanisms which are part of the air classifier system. The note column was used for recording details such as belt life and maintenance problems.

Approximately 5 kg of each sample was shipped in sealed containers by air freight to Cal Recovery Systems Inc. (CRS) for laboratory examination. When samples taken were larger than 5 kg they were coned and divided in accordance with accepted practices. Each sample was clearly marked for easy identification by the system shown below and entered on the sample handling log, Form A-6 in Appendix A. The sample numbering code used was as follows:

4596-G - X - X XX

Project No.
Site code
Stream sampled
Run No.

Stream sampled:
L = Lights
I = Input
H = Heavies

Test site examples:
A = Ames, Iowa
B = Baltimore County, Maryland
T = Tacoma, Washington

TRAVERSE POINT	DISTANCE, % of diameter
1	4.4
2	14.7
3	29.5
4	70.5
5	85.3
6	95.6

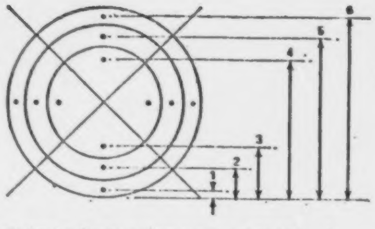

Figure 1 3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points indicated.

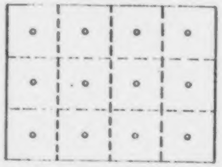

Figure 1 4. Example showing rectangular stack cross section divided into 12 equal areas, with a traverse point at centroid of each area.

LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

(Percent of stack diameter from inside wall to traverse point)

Traverse point number on a diameter	Number of traverse points on a diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8				96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10					97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.8	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	92.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

Source: Federal Register, Vol. 42(160):4175-4189, Thursday, August 18, 1977.

Figure 2. Data for determining traverse points.

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These samples were analyzed at CRS for composition, moisture, and size distribution.

Air classifier system tests followed the test protocol given below:

1. Set and measure airflow rate;
2. Set input feed (flow) rate;
3. Allow system to stabilize;
4. Stop input, lights and heavies conveyors;
5. Take a measured length of material from two conveyors;
6. Weigh sample and calculate flow rates; and
7. Repeat steps 2 through 6 as needed.

Material infeed rates of MSW were selected to provide a set of data points which would show the effect of input flow rate on air classifier separation at each of three airflow rates. This consisted of a range of approximately 0.1 to 2 times rated flow. This range of feed rates permitted assessment of classifier performance over a wide range of solids-to-air ratios. Airflow rates were selected to be the airflow for normal plant operating conditions, and one airflow at a higher rate and one airflow at a lower rate. Thus data are obtained at current operating conditions and airflows both above and below current plant practice. The material flow rates for each airflow were recorded on Form A-7 (shown in Appendix A).

Pressure drops across the air classifier and across the entire system are important measures of the air handling efficiency. Pressures were measured at the point where the velocity traverse was made, then at the outlet of the air classifier and at the outlet of the complete air system. The traverse location was usually between the cyclone and the fan. Form A-8 (shown in Appendix A) was used to sketch the system, show the pressure tap locations, and record the data.

Power requirements for the prime movers in the air classifier system were measured. The rationale for deciding which prime movers were part of the system was to include only those components unique to the system. Motors used to drive input and output conveyors were not included because all refuse processing systems must have this equipment.

A logbook was maintained in the field to record information that would affect the test results, such as unusual MSW composition. Facility operation problems which affected evaluation of that air classifier system were also recorded in the logbook. The on-site temperature, relative humidity, and barometric pressure were measured five times each test day and recorded on Form A-3 (contained in Appendix A). This weather information was supported by the official weather report taken from a local newspaper. Wind velocity and direction and cloud data were determined through observation without instruments.

Procedures used in field testing that were specific to each test location are discussed in the following section (Section 4).

DATA ANALYSIS

Data analysis was initiated by reducing field measurements to flow rates for air and solids refuse. Solids flow rates were determined for input feed as well as for the light and heavy fractions. Plots were made to examine the effect of feed rate on light fraction recovery at each of the airflow rates.

Next, laboratory analyses were run to determine particle size distribution, composition, moisture content, heating value, and ash content. Laboratory analysis and field measurement results are given in the Appendices. Laboratory analysis was not conducted for every test run because many individual field tests were at similar conditions in order to obtain good mass flow rate data. Samples for laboratory analysis were selected to encompass the full range of mass flow rate and airflow conditions.

The parameters determined for the light fraction are important in assessing the quality of the light fraction when used as an energy source. Composition of the fractions included weight of plastic and paper, aluminum, ferrous material, and other materials. The composition was determined for five sieving steps to aid in determining the effectiveness of the air classifier in separating plastic and paper from the refuse stream. The ash content coupled with that expected for paper and plastic provides an indication of noncombustible carry-through in the light fraction.

The electrical power requirements for the overall air classifier system were reduced to kilowatt-hours of energy required to process a megagram of refuse infeed. Values of energy usage were determined for each airflow setting. Measurements were not made at different refuse feed rates because early tests on the program indicated that the bulk of the energy was expended in air movement. This energy consumption information is valuable in comparing one air classifier with another.

Data obtained during the field tests are included in appendix tables for each test location.

Concentration factors for paper plus plastic and metal at each input MSW flow rate and each airflow were calculated. These are the ratio of concentration of the constituent(s) in the output stream to the concentration of the constituent(s) in the input stream, as shown below.

$$\text{Concentration factor} = \frac{\text{Wt\% of Paper and Plastic in Output Stream}}{\text{Wt\% of Paper and Plastic in Input Stream}}$$

Fuel residue will include ash plus noncombustibles carried over with the light fraction. Most of the ash and other residue must be removed from the fire box of the unit in which the fuel was used and disposed in a safe and environmentally acceptable manner. Some of the residue from the fuel will deposit on heat transfer surfaces such as boiler tubes, insulating these surfaces and reducing heat transfer. The deposits may also cause corrosion. For a number of reasons fuel residue other than the necessary ash from the fuel is undesirable. When a known quantity of fuel is burned, the quantity of noncombustible residue can be estimated from the quantity of ash produced by subtracting the average percentage of ash produced from the burning refuse lights containing only paper and plastic. The value of RDF can be judged from the percentage of combustibles found in the light fraction. Light fraction combustibles (LFC) from an air classifier can be determined by using the following relationship.

$$LFC = \frac{LF_w - (LF_A - 0.11)\ LF_w}{LF_w} \times 100$$

Where:

LFC = light fraction combustibles, %;
LF_w = weight of light fraction sample, g;
LF_A = decimal fraction of light sample that became ash when sample was burned; and
0.11 = the decimal fraction of ash expected if only paper and plastic were in the light fraction.[2]

The above relationship reduces to:

$$LFC = 111 - 100\ LF_A$$

This last relationship will allow an RDF producer to estimate fuel value by weighing a lights sample, burning the sample, and then weighing the ash.

The yield of paper and plastic in the light fraction from the refuse infeed is referred to as RDF yield. RDF yield can be determined by multiplying the light fraction split by the light fraction combustibles. The light fraction split is the percentage of light fraction separated from the infeed. RDF yield is calculated by applying the following relationship.

$$RDF\text{-}Y = \frac{LF_R}{IF_R} \times 100 \times LFC$$

Where:

$RDF\text{-}Y$ = yield of combustibles, %;
LF_R = light fraction feed rate, Mg/h;

IF_R = infeed rate, Mg/h; and
LFC = light fraction combustibles, %.

RDF yield can also be determined by an operator of a plant by taking sample weights and using the value determined for LFC.

When producing RDF from MSW through air classifier separation of lights and heavies, it is desirable to collect paper and plastic, which are the majority of the combustibles in the light fraction, without rejecting large quantities of paper and plastic to the heavies or carrying over an excessive amount of noncombustibles with the lights. The process must also handle MSW at or near the design rate in order to realize projected economics for the system.

A major purpose of a MSW processing facility producing RDF is to recover energy from the MSW. For most air classifiers it is expected that the light fraction material flow stream will have a higher heating value than the heavy fraction, because the light fraction will contain a higher percentage of combustibles. The heating value data results can then be used to evaluate the energy recovered or concentrated by the air classifier.

Heating values of lights and heavies, along with the mass fraction split at the air classifier, were used to calculate the energy content of the feed material. Recovered energy (alternatively energy recovered in the lights) is termed RE and defined as,

$$RE = \frac{(M_f\ HV)_{LT}}{[(M_f\ HV)_{LT} + (M_f\ HV)_{HY}]}$$

Where:

M_f = Mass fraction or split expressed as a decimal fraction and on an oven dry basis;
HV = High heating value on an oven dry basis;
LT = Light fraction; and
HY = Heavy fraction.

Heating values on an oven dry basis are used because this eliminates the effect of variable moisture content on the data, allowing more meaningful observations to be made concerning energy recovery.

In addition to the volumetric airflow rate (m^3/s) the weight of airflow (Mg/h) was calculated and recorded on the plots of the weight of light recovery versus infeed rate. This allows a dimensionless number of the air versus infeed rates to be easily determined. Either the air to solids (A/S) ratio or the solids to air (S/A) ratio can be used. The S/A ratio was used for subsequent plots because it resulted in a better graphic presentation on a linear scale.

AIR CLASSIFIER COMPARISONS

Air classifiers are compared on the basis of environmental benefits, economics, and performance. Air classification to recover metal and glass for recycling and separating paper and plastics for fuel is environmentally beneficial. Less material is sent to landfill sites where it may attract rodents and vermin or it may leach out chemicals, thus contributing to water pollution. Particulate matter whipped into the air by vehicles transporting material to the landfill site, by earth moving equipment, and by wind blowing over the loose overburden is also reduced. Another benefit of air classification is that the recovery of metal, glass, and a fuel contributes to the supply of energy resources.

Splitting the refuse stream and sending it to different processing locations, however, tends to generate particulate matter than can be airborne. This handling feature is an environmental negative. Therefore, comparison of the classifier systems from an environmental standpoint includes data on fugitive emissions of particulates and separation effectiveness, i.e., minimizing the material sent to the landfill.

Air classifier systems are compared on the basis of (a) their ability to split the infeed refuse into heavy and light fraction streams and at the same time concentrate heavies and lights in their respective streams, (b) characteristics for producing a light fraction over a range of infeed rates at three airflow rates, (c) their performance compared to their design capacity, (d) the quality of RDF produced, (e) the yield of combustibles from the infeed, (f) the quantity of air required to handle a unit weight of refuse, (g) specific energy consumption, and (h) capital costs of equipment.

With the exception of Ames, Iowa, the data from all the test sites for the majority of the airflow rates tend to show a uniform increase in the production of lights with infeed rate, an apparent transition zone, and then a continued increase of production of lights at a lower rate as the infeed rate is increased. The reason for the apparent transition zone is not fully understood, but it can be compared to the slugging phenomena found in fluidized bed and pneumatic transport work.[3,4,5] In addition, oscillatory flow, which is thought to be a possible cause of choking in the pneumatic transport of solids, has been described through the use of a mass-vibration model.[3] The decrease in the slope of the production rate curve beyond the transition point can possibly be attributed to channeling flow within the air classifier. The effect of channeling is to reduce the effective cross-sectional area of the air classifier and to increase the average air velocity in the channeled zone. This explanation appears to be consistent with the observed data.

Light fraction production rate curves are expected to be of significant value to the MSW facility operators. The operators will be able to predict light fraction production with feed rate. If this fraction is sold or furnished as a fuel, the operators can select the required feed rate to meet their commitments to supply specific quantities of RDF.

In selecting the feed rate, the operator needs to balance operating problems and other factors against the projected production rate for lights. Smoothest operation will probably be encountered below the transition zone. Operating within the transition zone is not desirable because little if any change of light fraction production is realized for an increase of infeed rate. Above the transition zone, the percentage of recovery of lights from MSW is lower than that found below the transition zone and lights output is more variable.

The quality of the RDF depends on the higher heating value, moisture content, and fuel residue. Moisture in the fuel is vaporized when fuel is burned; consequently, the energy available from the fuel is reduced. RDF can be expected to have a moisture content ranging from 2 to 42%, with an average of 27%,[6,7] which cannot be controlled by the process plant without introducing another process step. Procedures can be avoided, however, which would increase the moisture level in the RDF.

The ash content in the light fraction provides an indication of noncombustible carry-over with the lights. This carry-over is usually in the form of pulverized glass, grit, and some metal. Ash from the burned paper and plastic can be expected to be about 10 to 12% weight;[2] however, on occasion, lower ash content will be found particularly when a disc screen[7] is used ahead of the air classifier system. Therefore, when ash values of the light fraction are below this 10 to 12% range, it can be concluded that little if any noncombustibles are carried over with the light fraction.

SECTION 4

RESULTS OF AIR CLASSIFIERS EVALUATED

Evaluation results are presented and discussed in five parts: (a) general description of the overall refuse plant and the isolation of the air classifier system, (b) air classifier design and design performance, (c) operating experience gained through the use of the air classifier system, (d) economic data for the air classifier system, and (e) results obtained from actual field tests.

The order in which each air classifier is discussed is kept consistent throughout the sections of this report including the appendix. This order is simply the time sequence in which they were tested starting from the first test and continuing to the last. The order of discussion is:

- Tacoma, Washington - Large, horizontal
- Baltimore, Maryland - Large, vertical round with dispersion cone
- Richmond, California - Small, vertical rectangular
- Ames, Iowa - Large, modified vertical rectangular
- Los Angeles, California - Small, vertical dual vortex
- Akron, Ohio - Large, vibrating fluidized bed
- Pompano Beach, Florida - Small, vibrating fluidized bed

HORIZONTAL AIR CLASSIFIER--TACOMA, WASHINGTON

General Description of Refuse Plant

The Tacoma, Washington, plant was designed to process MSW at a rate of 73 Mg/h (80 ton/h) to produce a fuel fraction and recover ferrous metal. A schematic diagram of the overall system is shown in Figure 3. Primary parts of the system consist of the tipping floor, shredder, air classifier, settling chamber, and magnetic separator. Figure 4 is a photograph of the plant. The entire system is covered to keep spillage and flying material to a minimum. The control console has closed circuit television receivers to facilitate monitoring critical locations within the plant. Plant operation is described below.

Packer trucks dump MSW on the enclosed tipping floor, which has an area of 2,230 m^2 (24,000 ft^2). A small dozer is used to push the dumped material into a trench containing the conveyor that feeds the shredder. The last part of the conveyor is enclosed. The enclosure is equipped with three sets of chains and a rubber curtain to contain projectiles from the shredder. The shredder is a Williams Model 680 driven by a 597-kW (800-hp) Allis Chalmers

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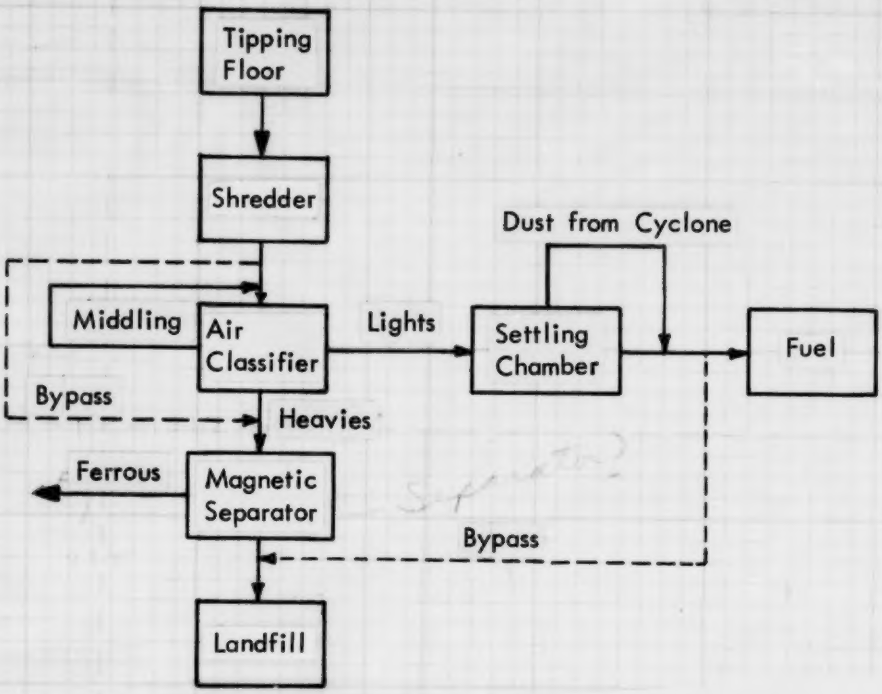
Tipping Floor
Shredder
Dust from Cyclone
Middling
Air Classifier
Lights
Settling Chamber
Fuel
Bypass
Heavies
Ferrous
Magnetic Separator
Bypass
Landfill

Figure 3. Municipal solid waste system flow diagram - Tacoma, Washington.

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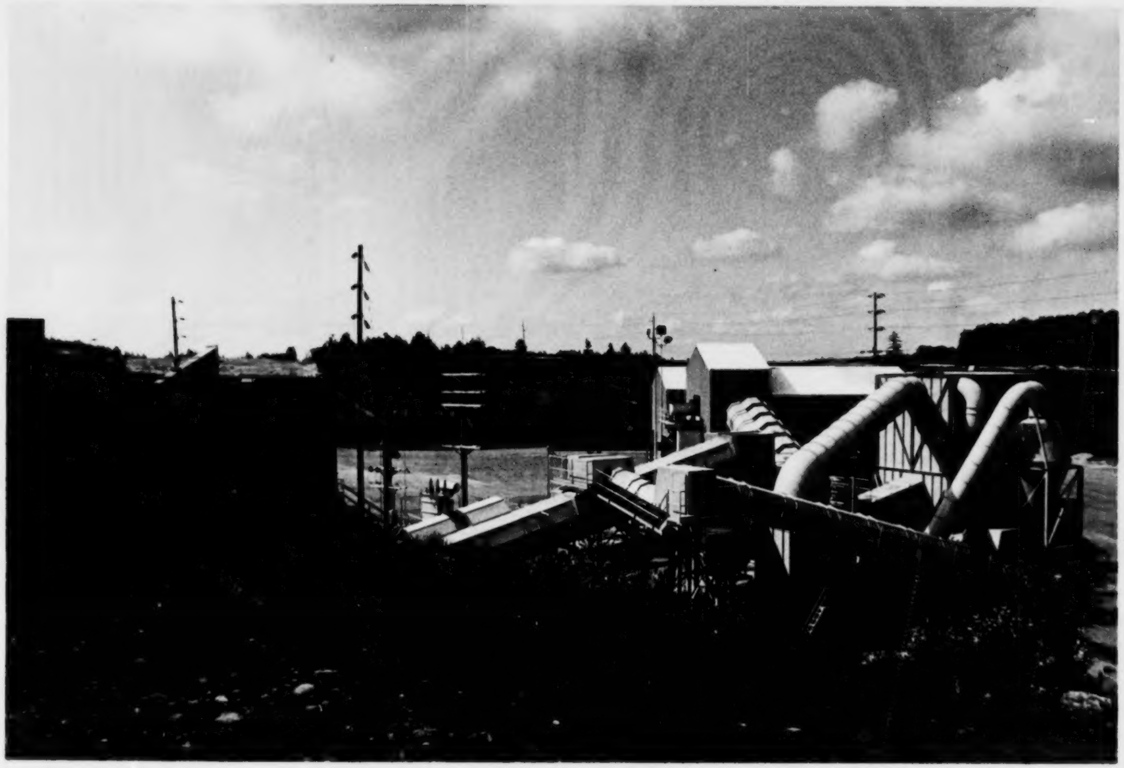

Figure 4. Plant processing line - Tacoma, Washington.

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induction motor coupled directly to the shredder motor shaft. Shredded MSW falls onto a pan conveyor and is carried to an inclined troughed rubber conveyor which dumps the material onto a horizontal conveyor that feeds the air classifier. Outputs from the air classifier are in three forms: lights, middlings, and heavies. The light material falls to the bottom of a settling chamber onto an inclined, troughed rubber conveyor. The settled light material is conveyed under cover to a truck loading system. The middlings exit the air classifier onto a second inclined conveyor to be recycled into the air classifier input. The heavies exit the air classifier onto a flat conveyor belt. This conveyor passes under an Eriez magnetic separator. The ferrous material is collected in an open trailer for sale to a salvage dealer. The remainder of the heavies are collected in another open trailer and are taken to a landfill site.

The Tacoma system has the necessary conveyors to allow bypassing of the air classifier to the heavies conveyor sytem. Also, there is a conveyor system inside the first loading building which allows switching of the material flow between the heavies and lights system.

Air Classifier System

The air classifier system is shown in Figure 5. The system, as defined for this evaluation, includes the air classifier, settling chamber, middlings return conveyor system, three fans, and dust cyclone separator with air lock. The air classifier is shown diagrammatically in Figure 6. The shredded MSW and the return middlings enter the air classifier on the conveyor at the upper right. The material falls over the conveyor head pulley, slides down the curved plate, and enters the main airstream from Fan 1 (see Figure 5). The lightest material is caught in the airstream. Gravity pulls the material toward the floor of the unit which is made up of two air plenums (see Figure 6). These plenums have perforated plates for top surfaces. The air escaping through these perforations forms a cushion for the heavy material which reduces friction enough to allow the main airstream to move the material forward onto and out of the heavies conveyor opening in the bottom of the unit. There are two inclined air currents produced by the air from Fan 3 flowing out of the curved ducts. These air currents lift some of the material into the main airstream. The final separation takes place at the bang boards. Everything that hits the first bang board falls onto the heavies conveyor and then goes to the ferrous separator. The second bang board separates the middlings material, which is recycled onto the air classifier input conveyor for another pass through the system. The material which passes both bang boards enters the settling chamber. In the settling chamber the material drops out of the air and falls onto a conveyor located between the sloped sides at the bottom of the chamber.

Three fans are used to generate the airflow in the air classifier system. An air flow diagram is shown in Figure 7. The system uses 100% recirculated air with a distribution box for the return air to Fans 1 and 3.

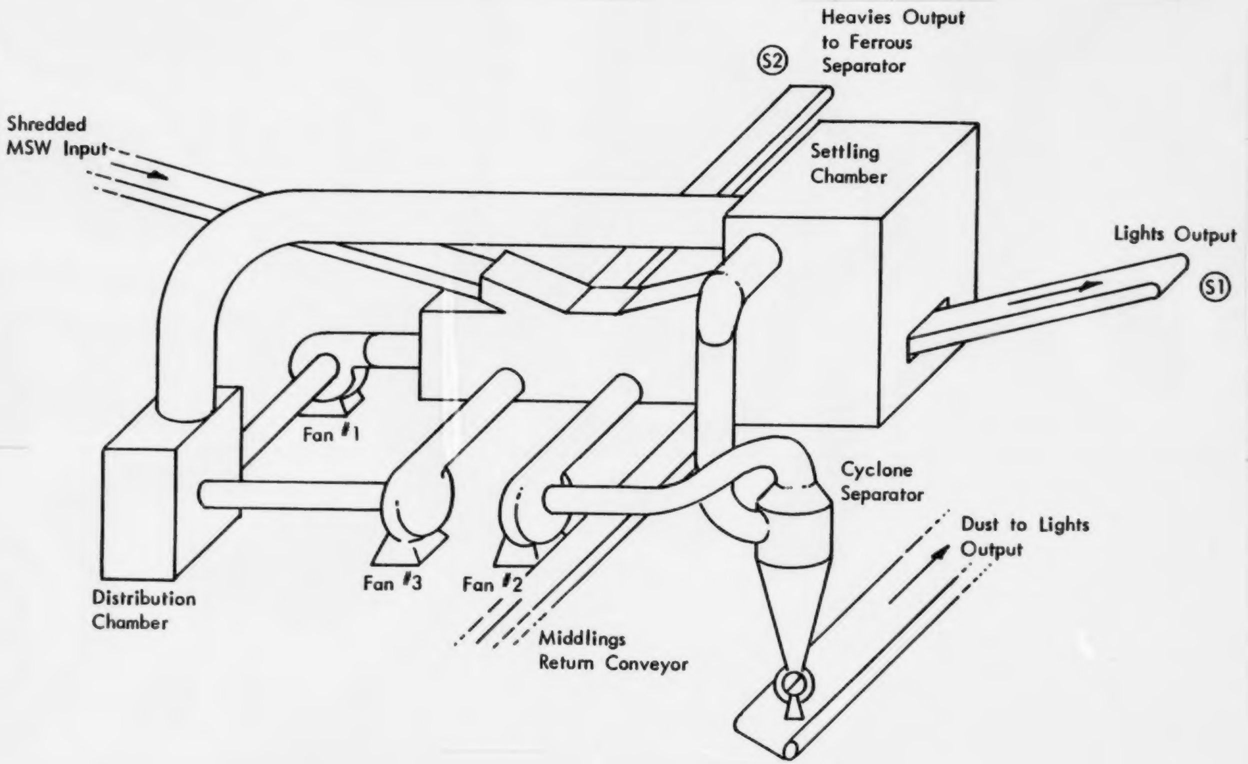
Heavies Output
to Ferrous
Separator
S2
Shredded
MSW Input
Settling
Chamber
Lights Output
S1
Fan #1
Cyclone
Separator
Dust to Lights
Output
Distribution
Chamber
Fan #3
Fan #2
Middlings
Return Conveyor

Figure 5. Air classifier system - Tacoma, Washington.

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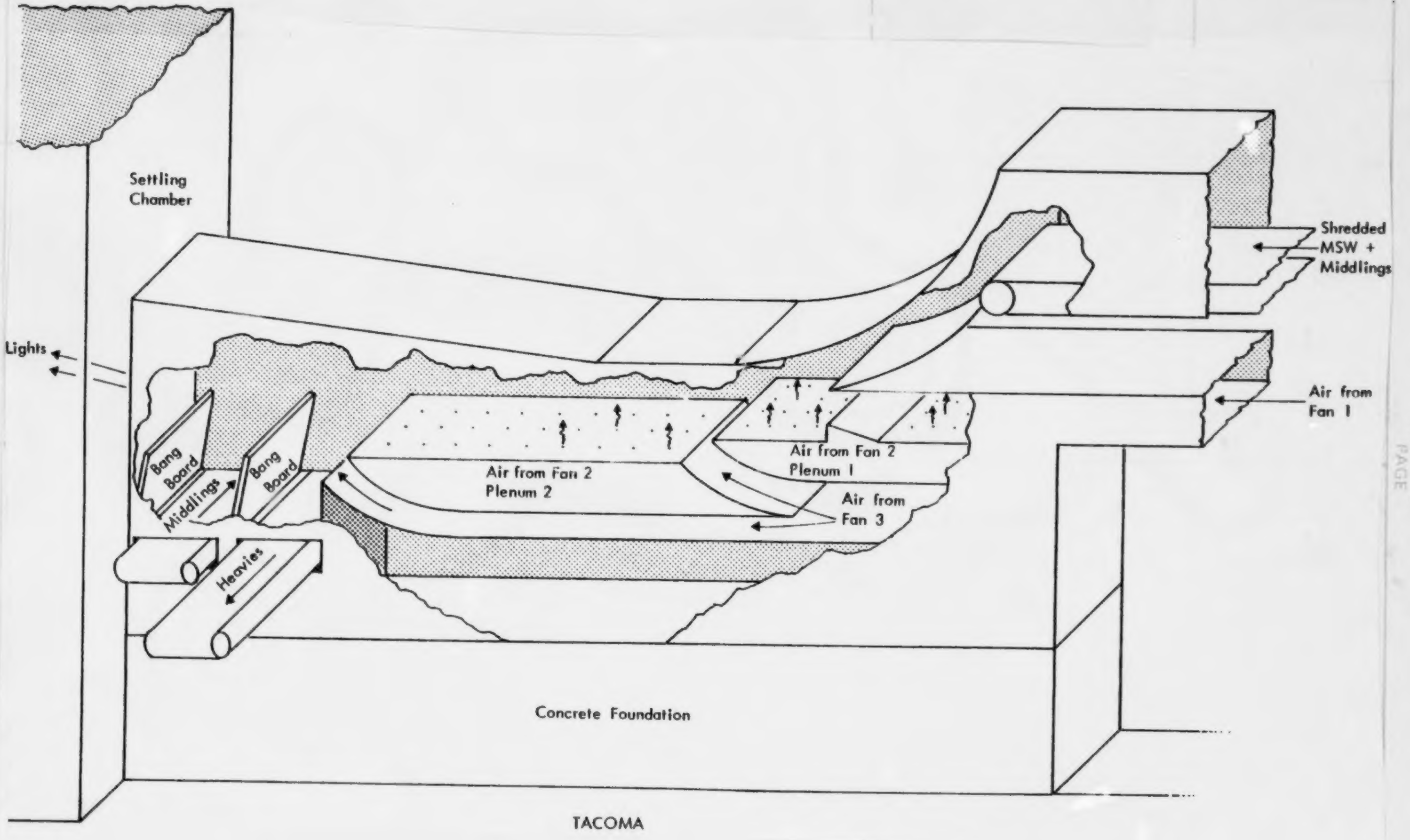
Settling Chamber
Shredded MSW + Middlings
Lights
Air from Fan 1
Bang Board
Bang Board
Middlings
Air from Fan 2 Plenum 2
Air from Fan 2 Plenum 1
Air from Fan 3
Heavies
Concrete Foundation
TACOMA

Figure 6. Air classifier - Tacoma, Washington.

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Fig 23

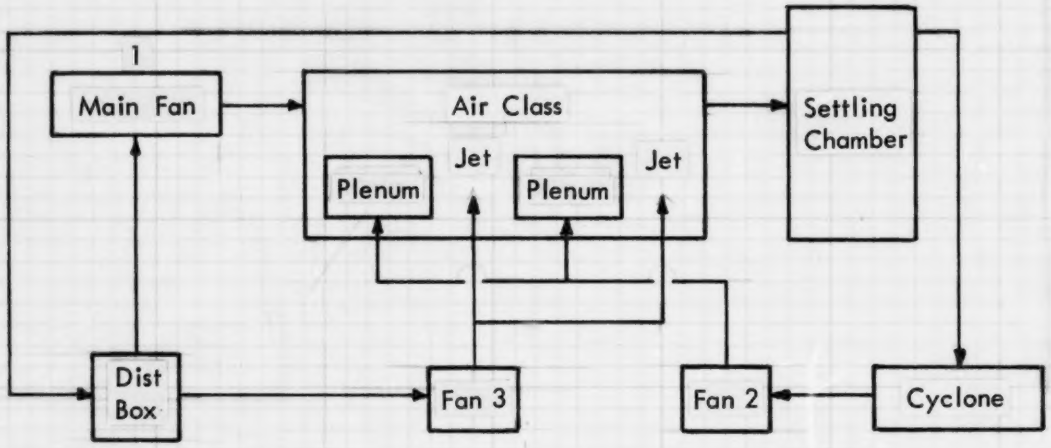

1
Main Fan
Air Class
Settling Chamber
Plenum
Jet
Plenum
Jet
Dist Box
Fan 3
Fan 2
Cyclone

Figure 7. Air classifier airflow diagram - Tacoma, Washington.

The air for Fan 2 comes from the settling chamber through the dust-removing cyclone. The 100% recirculated air feature eliminates emissions and circumvents the need for baghouses or other air cleanup devices. Fan 1 is the main air supply feeding into the input end of the air classifier. It is driven by a 45-kW (60-hp) motor. Fan 1 was run at three fan speeds, which resulted in the three airflow rates during the air classifier tests. Fan 2 was run at constant speed throughout the air classifier test because of system design constraints. The recirculating feature of the system changes the airflow through this fan as a result of changing the speed of the other fans. This fan feeds the two plenums in the air classifier. Fan 3 supplies the air for the two lifting air currents. The speed of this fan was increased along with that of Fan 1 to produce the three test airflows.

Design Performance

The air classifier system design included one air classifier, associated settling chamber, fans and motors, dust separator, discharge conveyors, connecting duct work, internal wiring, and internal fire protection equipment. The air classifier was specified to be similar or equal to Boeing Model MSW-100A as manufactured by Solid Waste Systems (M/S 8K-65), Boeing Engineering and Construction. The air classifier was specified to have a nominal operating material flow rate of 72.6 Mg/h (80 ton/h) and to be capable of peak flows to 91 Mg/h (100 ton/h). Connected base power was not to exceed 169 kW (227 hp).

A calculated design life of 10 years with usual prescribed maintenance was specified with exemptions for electric motors, conveyor belts, and surfaces or parts subject to high wear. Design of the system was to provide easy access to the parts and surfaces expected to be subjected to high wear.

The air classifier was required to separate shredded household refuse into light (mainly combustible) and heavy (mainly noncombustible) fractions. The light fraction was to contain 70% or more, by weight, of the combustibles which were in the input stream and a maximum of 7%, by weight, of removable inerts (noncombustibles). Removable inerts are inert materials which will not pass a 0.64-cm (1/4-in.) screen sieve. The heavy fraction was to contain a minimum of 85% of the ferrous metals and 50% of the aluminum, by weight, in the input stream.

Particulate emissions in the exhaust air from the air classifier were to be less than 0.11 g/m^3 (0.05 grains per standard cubic foot).

Operating Experience

All mechanical components such as motors, fans, and belt drives were accessible for maintenance. The air classifier system was constructed for rugged treatment. Doors were needed for easy access to the inside of the air classifier. Cloth and other fibrous materials became caught inside the unit and had to be removed every 2 to 3 days. Additional instrumentation would improve operation of the system, e.g., air pressure gauge or flow meter to indicate when holes in plenum are plugged. Since it is often desirable to slow down or speed up the infeed conveyor belt, a variable speed drive would provide the needed feed rate flexibility.

Economic Data

The air classifier system was installed for $452,500 in 1978. This cost on the basis of refuse infeed handled is $6,233/Mg/h ($5,656/ton/h) of normal operating capacity of 72.6 Mg/h (80 ton/h) and $4,986/Mg/h ($4,525/ton/h) of 90.75 Mg/h (100 ton/h) surge capacity. System maintenance for the air classifier part of the Tacoma, Washington, plant was not available.

Results of Performance Tests

The infeed flow rate at the Tacoma plant was controlled by the amount of material on, and the speed of, the shredder infeed conveyor. Conveyor speed is controlled from the operator's panel with a dial graduated 1 through 10. Conveyor belt speeds were measured at various dial graduations so that a known belt speed could be set by the dial at the control console. The amount of material on the infeed conveyor belt was accomplished by the test crew loading and distributing MSW along the belt. First, the infeed portion of the conveyor to the shredder was filled to a predetermined level and moved forward 10.7 m (35 ft) to the shredder. Then the rest of the conveyor was filled. The conveyor speed control was set to the desired speed, and the material was fed through the system. The full conveyor provided enough material to stabilize the air classifier system. The time to stabilize the system was determined by the time needed to get the middling material back to the input conveyor; this was observed on the television monitor. The system was shut down before the infeed material was depleted, and a measured length of material was taken off both the heavies and lights output conveyors. Given the length and weight of material from a belt that was traveling at a known speed, the flow rates were calculated. It was estimated from observations that approximately the same amount of material was being recirculated as middling for a specific input flow rate; therefore, the input was determined by adding the two outputs.

The conveyor system was designed for the expected 72.6 Mg/h (80-ton/h) shredding rate. This 72.6 Mg/h infeed maximum was far below the capability of the air classifier; therefore, the air classifier infeed conveyor had to be loaded by a special method to facilitate testing the air classifier at infeed rates in the range of its designed capacity. This loading of the air classifier infeed conveyor was accomplished by jogging the conveyor forward to allow the shredder material to pile up. A member of the test crew then leveled the load with a rake. Air classifier infeeds of 127 Mg/h (140 ton/h) were achieved by this loading technique. Because of the short length of the conveyor, it was necessary to reduce the air classifier stabilizing time by loading the middlings recirculating conveyor system before feeding this material into the air classifier.

Power measurements were made on Fans 1, 2, and 3; four conveyors required for middling return; one air lock (the dust cyclone); and one conveyor for the dust cyclone output. Power measurements were made when the system was not processing material, but measurements were made on Fan 1 while material was being processed.

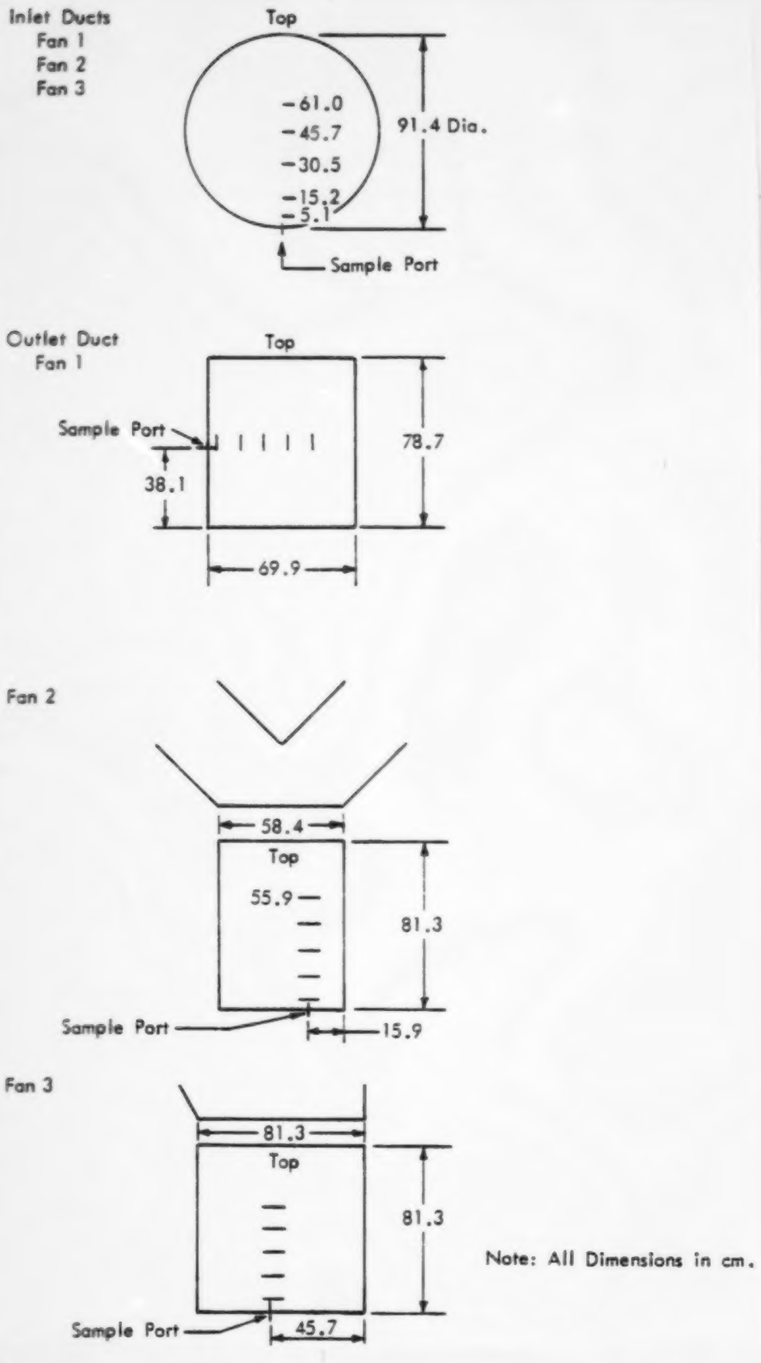
Air classifier performance was tested at three airflow rates. The airflow rates of Fans 1 and 3 were increased by installing larger sheaves on the fan motor shafts. The design of the air classifier required that the speed of Fan 2 remain constant. The airflows were determined by making pitot tube traverses of the inlet and outlet ducts from each fan for each fan setting. Average air velocity and total pressure were determined in both the inlet and outlet ducts. Pitot tube traverse locations for data collection are shown in Figure 8.

Data obtained during the performance tests are included in Tables B-1 through B-9 in Appendix B. Concentration factors for paper and plastic and metal at each input MSW flow rate and each airflow are shown in Table 2.

This table clearly shows that the air classifier concentrates paper and plastic as well as aluminum and ferrous materials. For paper and plastic, concentration factors range from a low of 1.11 to a high of 1.35. The lowest and highest concentration factors were obtained at the middle airflow rate. The lowest average concentration factor was obtained at the highest airflow rate and the highest at the lowest airflow rate. There does not appear to be a trend of concentration factor versus input feed rate at any of the three airflow rates tested.

Concentration factors obtained for aluminum and ferrous materials were higher than those obtained for paper and plastic. The concentration factor for aluminum and ferrous materials ranged from a low of 1.73 to a high of 3.91. The highest average concentration factor for aluminum and ferrous material was realized at the highest airflow rate, whereas the lowest average concentration was realized at the lowest airflow rate.

The ability of the air classifier to handle refuse at each airflow is shown in Figure 9. A plot of the weight of light fraction production versus the infeed rate to the air classifier is given in these figures. The trend of increased production of the light fraction with increased infeed rate is evident at all three airflow rates tested. This trend reaches an apparent peak and then starts to decline somewhere between infeed rates of 87 and 127 Mg/h for the lowest airflow (37.49 m^3/s) and between 83 and 120 Mg/h at the middle airflow rate (38.94 m^3/s). However, no decline is observed at the highest airflow rate (45.20 m^3/s) at feed rates to 116 Mg/h. The apparent slope of the trend lines through the data increases with airflow rate. From the standpoint of producing a light fraction, the highest airflow rate is preferred. However, since the plant can only process MSW at rates to 73 Mg/h, the air classifier could be operated at each of the test airflows without encountering a transition zone.


Inlet Ducts
Fan 1
Fan 2
Fan 3
Top
61.0
45.7
30.5
15.2
5.1
91.4 Dia.
Sample Port
Outlet Duct
Fan 1
Top
Sample Port
38.1
78.7
69.9
Fan 2
58.4
Top
55.9
81.3
Sample Port
15.9
Fan 3
81.3
Top
81.3
Sample Port
45.7

Note: All Dimensions in cm.

Figure 8. Duct traverse points for pitot tube - Tacoma, Washington.

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TABLE 2. CONCENTRATION FACTORS FOR HORIZONTAL AIR CLASSIFIER - TACOMA, WASHINGTON

Feed rate Mg/h	Factors at airflow of 37.49 m^3/s	Feed rate Mg/h	Factors at airflow of 38.94 m^3/s	Feed rate Mg/h	Factors at airflow of 45.20 m^3/s
		Paper and Plastic			
33.34	1.14	12.50	1.17	25.55	1.32
43.42	1.23	50.46	1.19	58.94	1.15
54.51	1.23	82.22	1.11	75.07	1.13
87.12	1.27	120.17	1.35	79.60	1.15
127.15	1.28			116.29	1.14
Average	1.23	Average	1.21	Average	1.18
		Ferrous and Aluminum Materials			
33.34	1.79	12.50	3.49	25.55	2.40
43.42	1.91	50.46	2.54	58.94	2.03
54.51	2.01	82.22	3.00	75.07	3.16
87.12	2.39	120.17	1.73	79.60	3.67
127.15	1.92			116.29	3.91
Average	3.00	Average	2.69	Average	3.03

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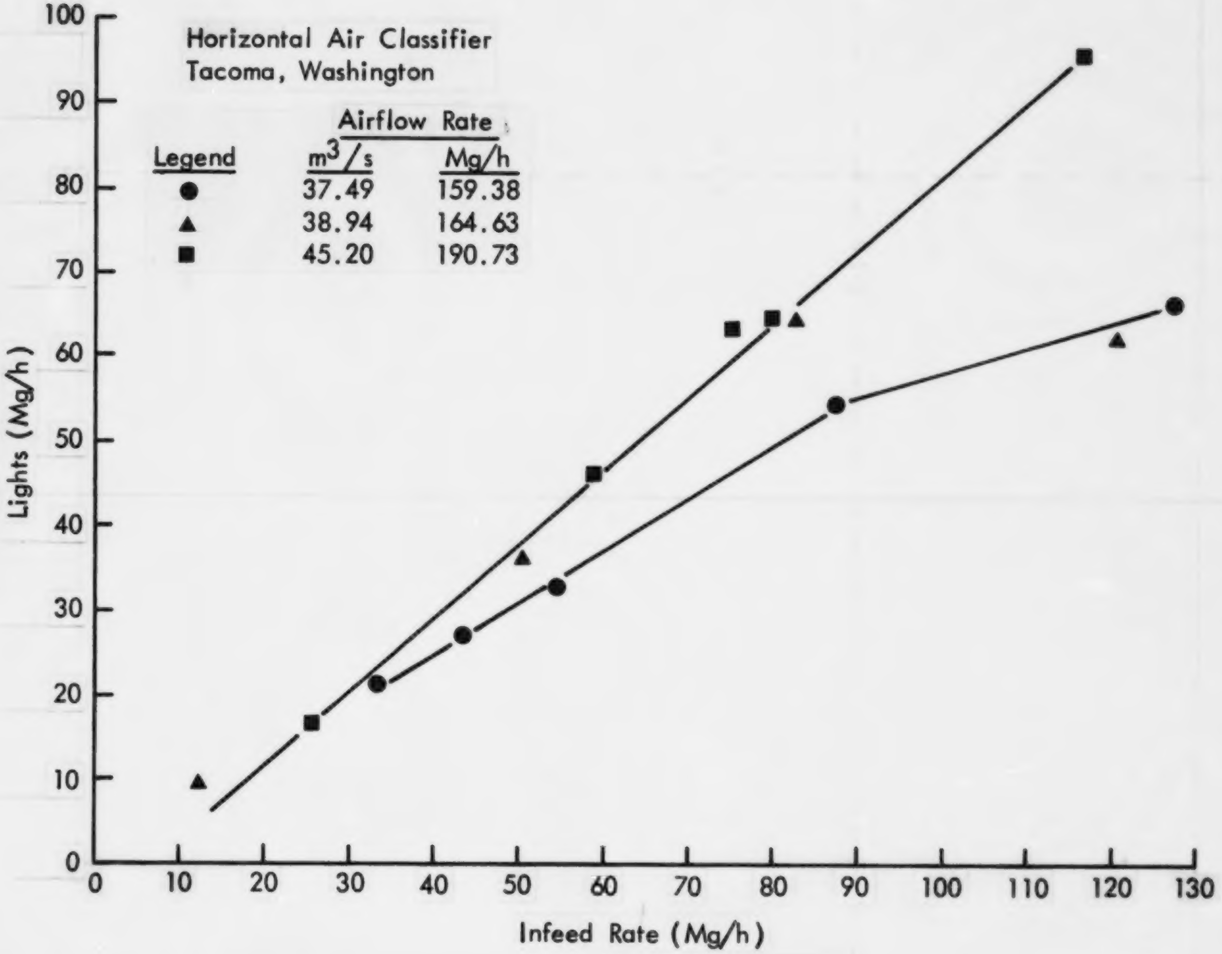

Figure 9. Lights production rate as a function of infeed rate - Tacoma, Washington.

Ash content for the light and heavy fractions is given in Table B-1 in Appendix B. The ash content of the light fraction produced with the Tacoma air classifier ranged from a low of 25.9% to a high of 39.2%. These values clearly indicate that this air classifier carried over a sizable quantity of noncombustibles along with the light fraction. The relatively large quantity that passed through the smallest sieve (see Table B-6) and the weight in the aluminum, ferrous, and "other" categories of the sample composition (see Table B-7) tend to support the statement that substantial quantities of noncombustibles were carried over with the lights. This quantity is high enough to suggest that an additional step be added to the RDF process to eliminate a large portion of these noncombustibles.

Ash content in the heavy fraction was generally much higher than in the light fraction (see Table B-1). Ash content of the heavy fraction ranged from 44.4 to 72.1%. High ash content in the heavy fraction is expected because heavies in MSW are composed predominantly of metals and other noncombustibles.

Figure 10 shows LFC plotted against shredded MSW infeed rate to the air classifier. The average LFC values at the low, middle, and high flow rates were 78.2, 81.8, and 78.3%, respectively. LFC values tended to decrease slightly with refuse infeed rate at each airflow rate.

Figure 11 shows the RDF yield versus infeed rate for each of the three airflows. At the highest airflow rate, combustible yield increased and then decreased with infeed rate. At the other airflow rates, RDF yield decreased slowly first and then more rapidly at the higher infeed rates. This trend was particularly noticeable at the middle airflow rate. The average RDF yield increased with airflow.

Measured electrical power requirements for the drivers for three fans plus five conveyors and the cyclone air lock are shown in Table B-9 in Appendix B. Total power for the air classifier system was 89.2 kW at the lowest airflow rate, 98.5 kW at the middle airflow rate, and 126.1 kW at the highest airflow rate. Power requirements for Fan 1 were measured loaded and at no load at all three airflow rates. Power requirements increased less than 10% when the air classifier was loaded. A review of the performance curves indicates that the lowest airflow rate should be adequate to process refuse at the plant design rate of 72.6 Mg/h. Thus the specific energy consumption is 1.23 kWh/Mg.

A plot of paper and plastic in the heavies versus infeed rate to airflow rate weight ratio is given in Figure 12. The infeed rate to airflow rate ratios at the rated capacity of the air classifier (73 Mg/h) for the low, middle, and high airflow rates were 0.46, 0.44, and 0.38, respectively. At all airflow rates, paper and plastic in the heavies made up less than 50%. On the basis of paper and plastic rejection to the heavies at all infeed rates, the highest airflow rate is preferred.

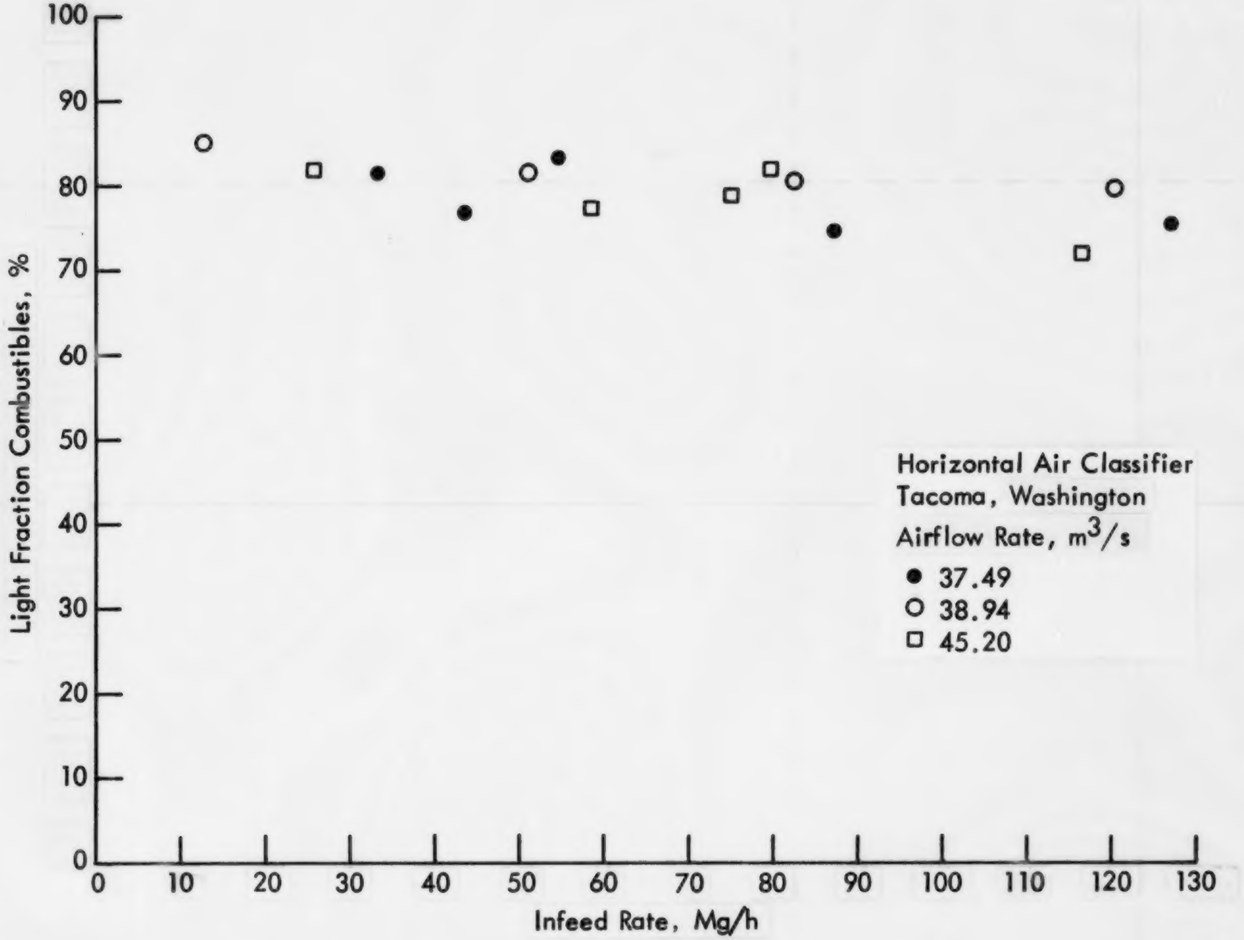

Figure 10. Light fraction combustibles versus infeed rate - Tacoma, Washington.

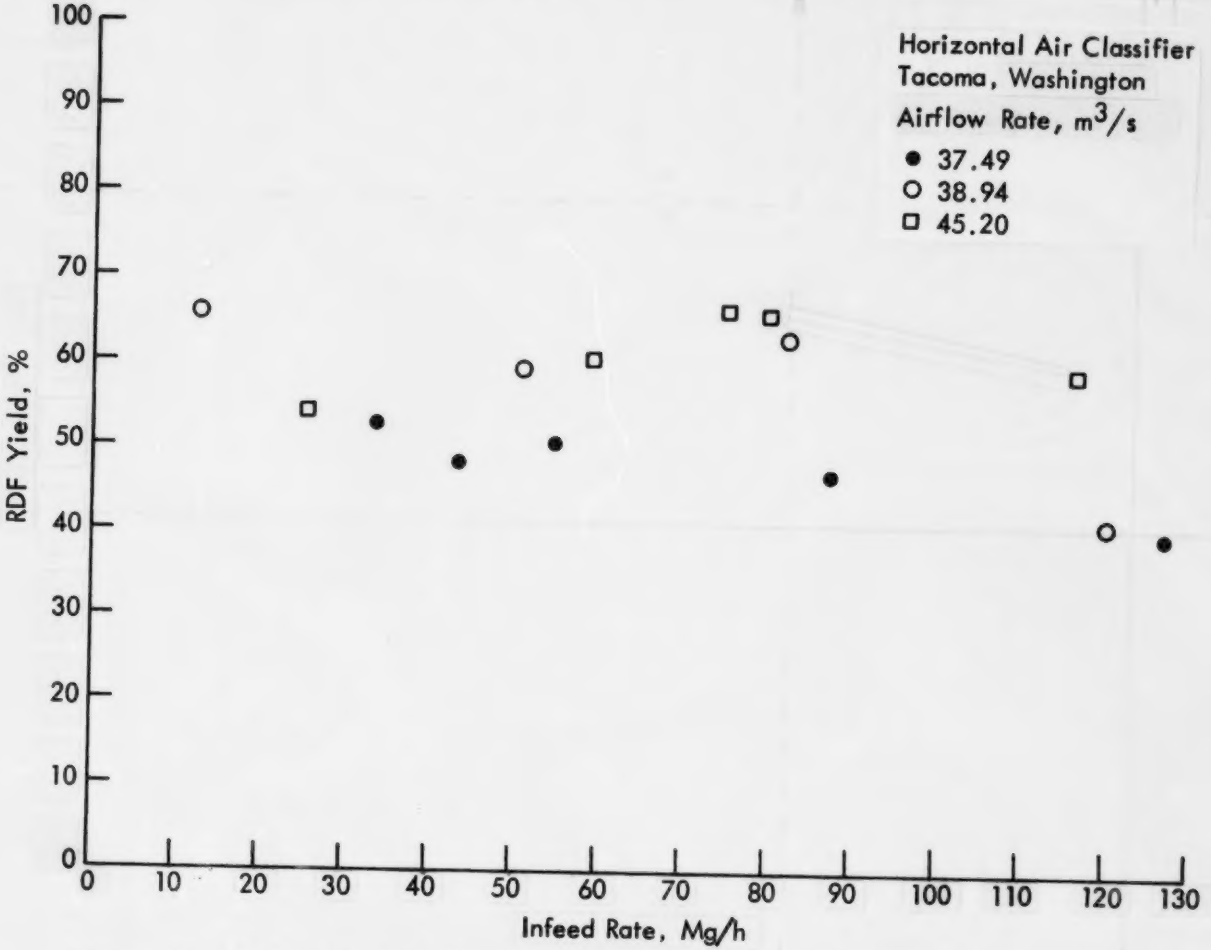

Figure 11. Refuse-derived fuel yield versus infeed rate - Tacoma, Washington.

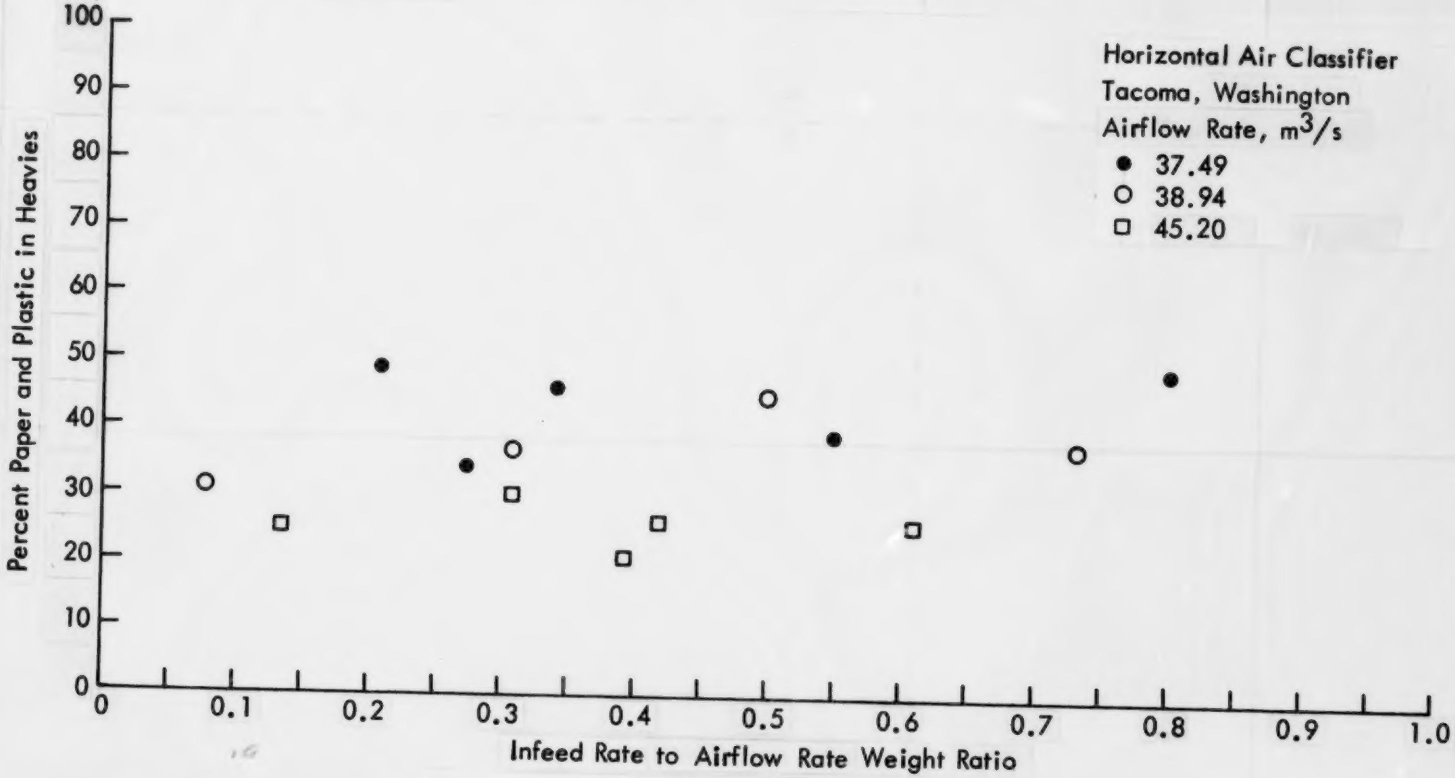

Figure 12. Percentage paper and plastic in heavies versus solids to air weight ratio - Tacoma, Washington.

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A plot of percentage of ash from lights versus infeed rate to airflow rate weight ratio is given in Figure 13. The level of ash content at all airflow rates shows considerable noncombustibles were carried over with the lights at each infeed rate with a trend of increasing ash with increasing infeed rate to airflow rate ratios at all airflows.

A plot of percentage of lights produced versus infeed rate to airflow rate weight ratio is shown in Figure 14. It can be seen that the highest production of lights within the rated capacity range of the air classifier occurs at the highest airflow rate.

Average oven dry basis heating value for the eight samples analyzed for heating value is 15,401 kJ/kg for the lights and 11,205 kJ/kg for the heavies, a 27.2% difference. Therefore, light fraction energy recovery is higher than light fraction material weight recovery. Percentage of total energy contained in the infeed recovered by the air classifier in the light fraction varied between 89.8% and 57.8% and is plotted in Figure 15. The trend is that the higher percentage energy recoveries occur at the midrange infeed flow rates and at the higher airflow rates, although differences due to infeed flow rate were not pronounced below 82 Mg/h.

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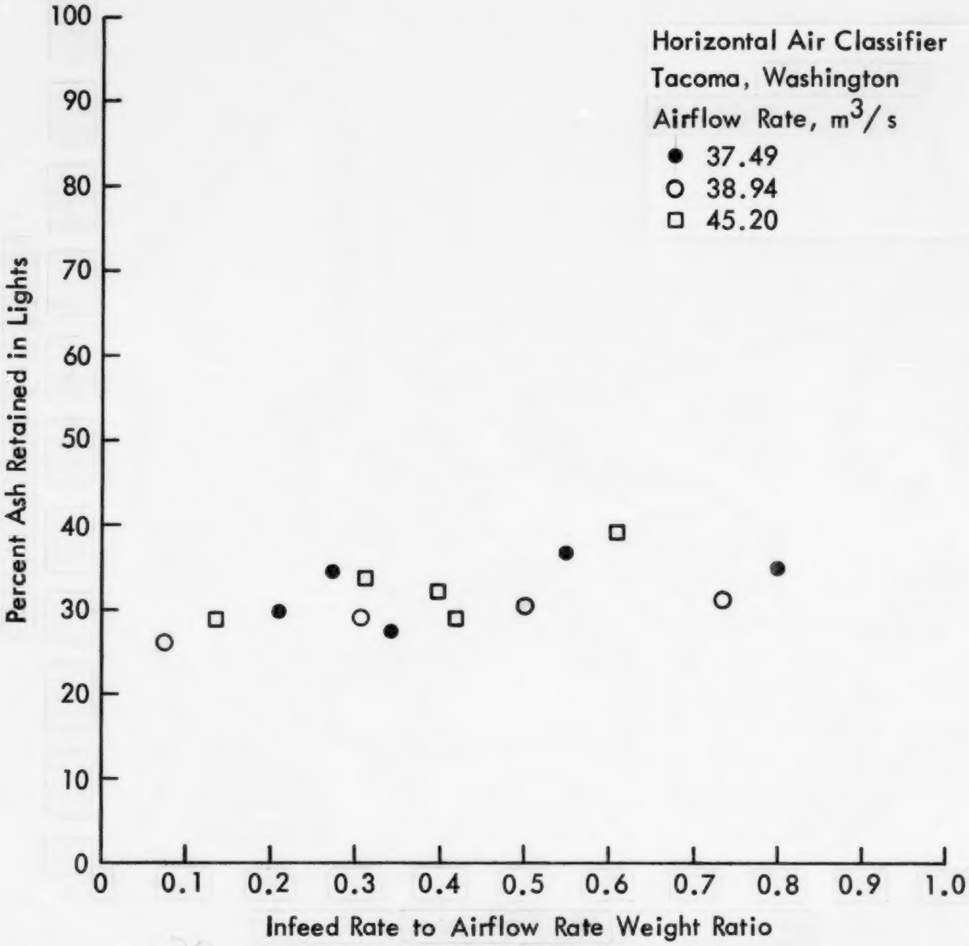

Figure 13. Percentage ash retained in lights versus solids to air weight ratio - Tacoma, Washington.

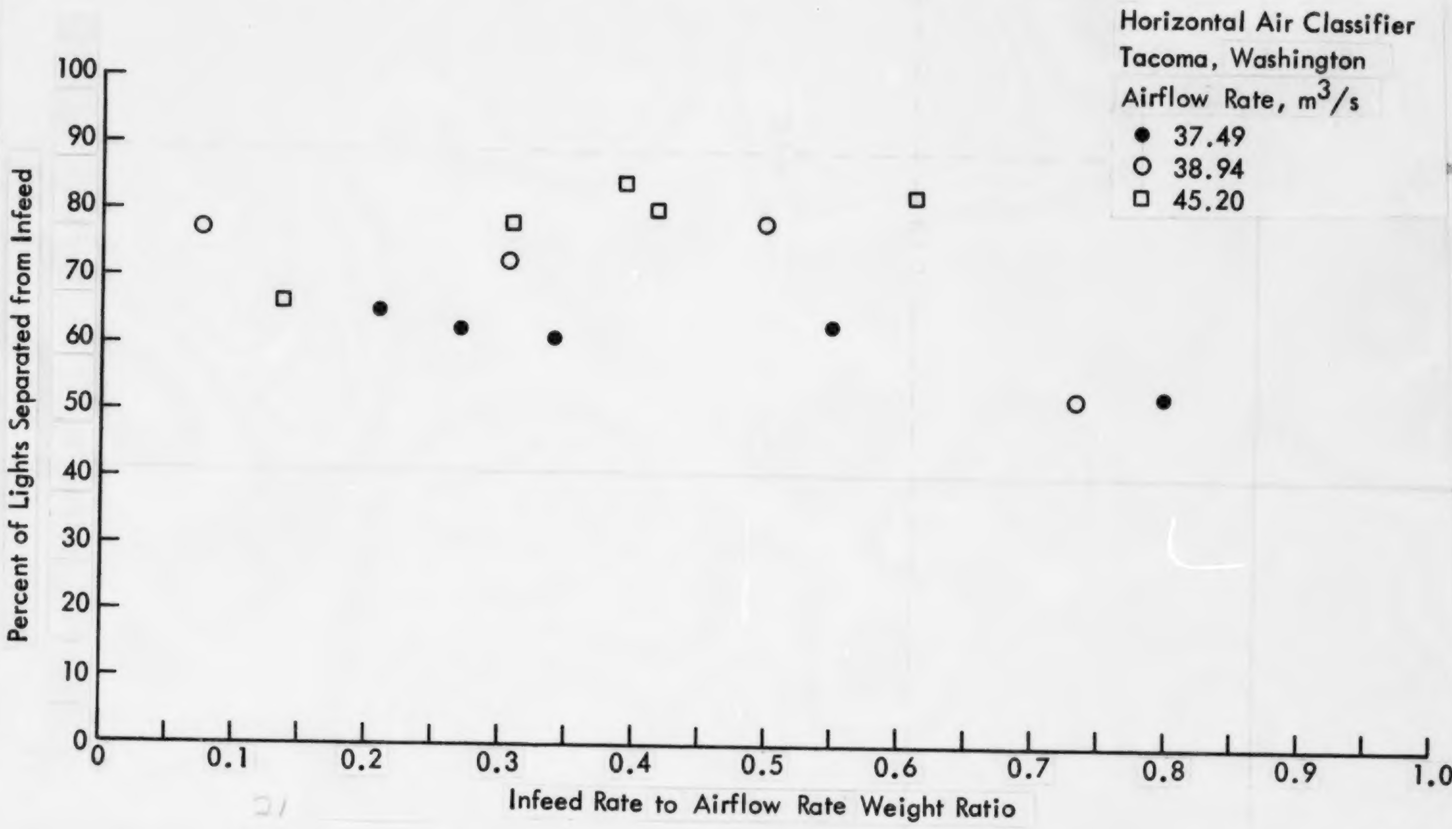

Figure 14. Percentage of infeed reporting to lights versus solids to air weight ratio - Tacoma, Washington.

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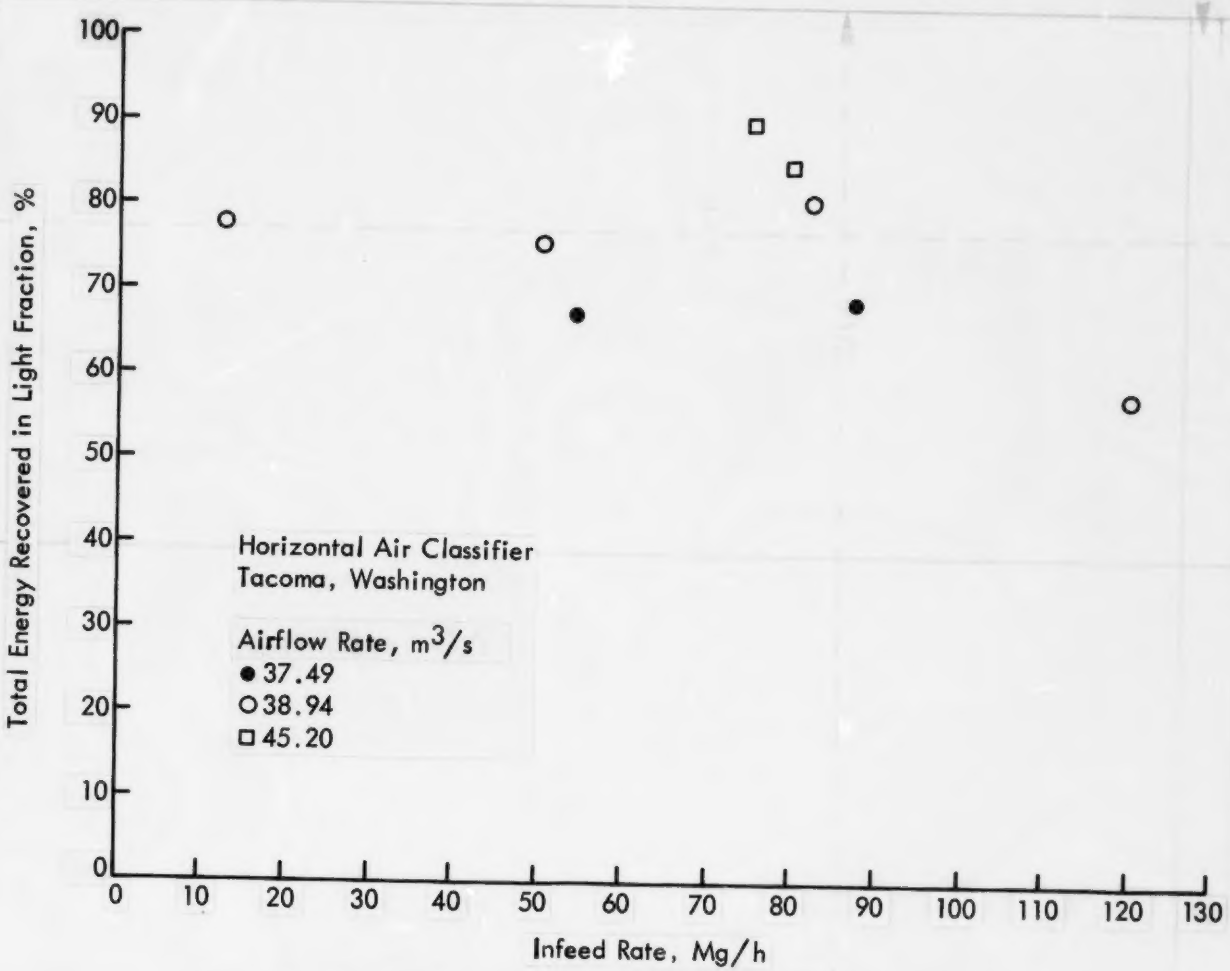

Figure 15. Energy recovery versus infeed rate - Tacoma, Washington.

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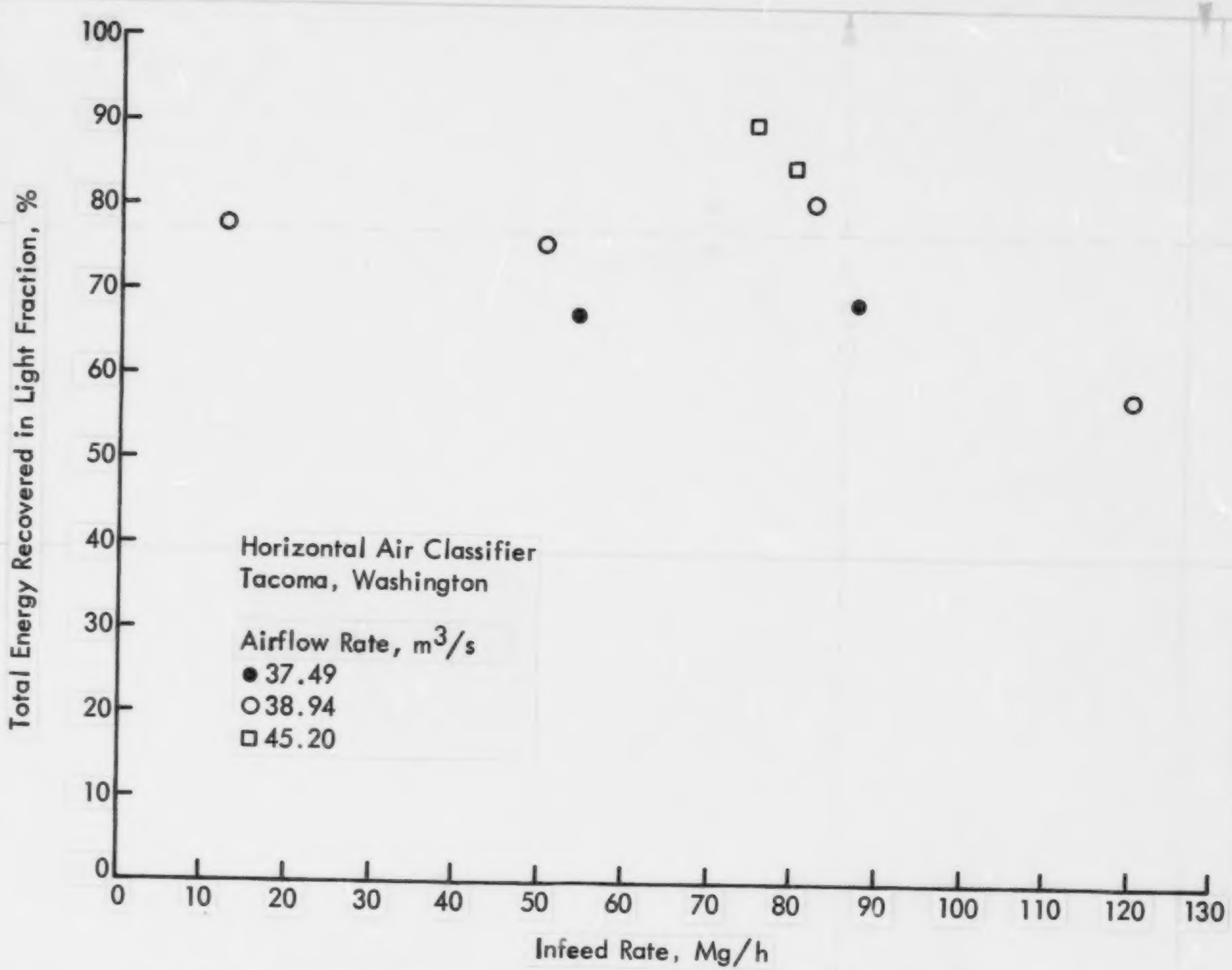

Figure 15. Energy recovery versus infeed rate - Tacoma, Washington.

VERTICAL CYLINDRICAL AIR CLASSIFIER WITH DISPERSION CONE--BALTIMORE COUNTY, MARYLAND

General Description of Refuse Plant

The Baltimore County, Maryland, system processes MSW at a design rate of 91 Mg/h (100 ton/h) while recovering ferrous metal and producing a fuel fraction. A schematic diagram of the overall system is shown in Figure 16. Primary parts of the system consist of a storage pit, push pits, shredders, magnetic separators, air classifier, cyclones, trommel and pelletizer. The shredding and ferrous recovery steps are accomplished prior to air classification, and the shredding step uses two Tracor Marksmen Model A60 shredders driven by direct-coupled 746-kW (1,000-hp) Tashiba motors. Two parallel Dings "hockey stick" belt magnetic separators are used for ferrous recovery. One portion of the total throughput is diverted for air classification in the vertical cylinder unit designed by Teledyne National. The other portion goes to a container for transport to a landfill. The light fraction of the classified material passes through a trommel for removal of grit, and the trommel oversize material becomes the fuel fraction, which is then pelletized into a densified refuse-derived fuel (d-RDF).

The front half of the plant, which includes shredders and magnetic separators, operates independently of the back half. The back half includes the air classifier, trommel, and pelletizer. The shredders and magnetic separator system are controlled from a separate location.

When operating, raw MSW is dumped either into the storage pit or one of the push pits. Any material in the storage pit is later transferred to the push pits with an overhead crane. Material is carried out of the push pits on metal pan conveyors and into the shredders. Rubber troughed conveyors are used to carry the material to the ferrous separators, and the recovered ferrous from both separators is conveyed into an open top trailer for shipment to a steel mill. The nonferrous material leaving the separator system is conveyed to a compactor for shipment to the landfill. Part of the flow to the compactor can be diverted to the air classifier by using the arrangement shown in Figure 17. Heavy material that enters the air classifier drops out the bottom. The light material entrained in the airstream is separated out of the air by two cyclones and enters a trommel where glass and grit are removed and taken to the landfill. The material passing through the trommel, as oversize, is densified into pelletized fuel for subsequent use in a boiler. The heavy material falling out the bottom of the air classifier is conveyed to the compactors for landfill.

Air Classifier System

The air classifier system is shown in Figure 18. The Baltimore County system includes the air classifier, two main fans, cone air fan, baghouse fan, and the two light fraction cyclones with air locks.

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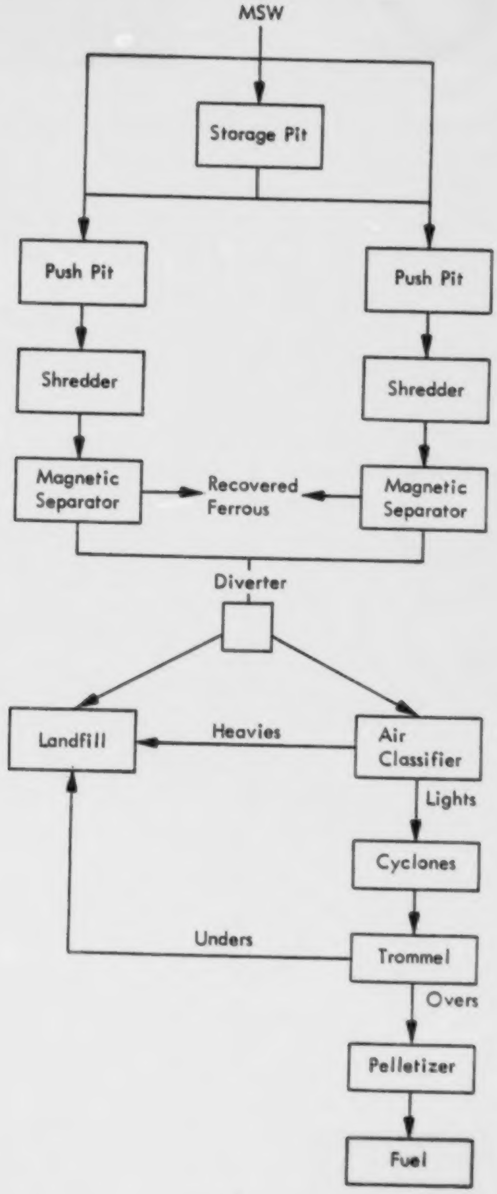
MSW
Storage Pit
Push Pit
Push Pit
Shredder
Shredder
Magnetic Separator
Recovered Ferrous
Magnetic Separator
Diverter
Landfill
Heavies
Air Classifier
Lights
Cyclones
Unders
Trommel
Overs
Pelletizer
Fuel

Figure 16. Municipal solid waste system flow diagram - Baltimore County, Maryland.

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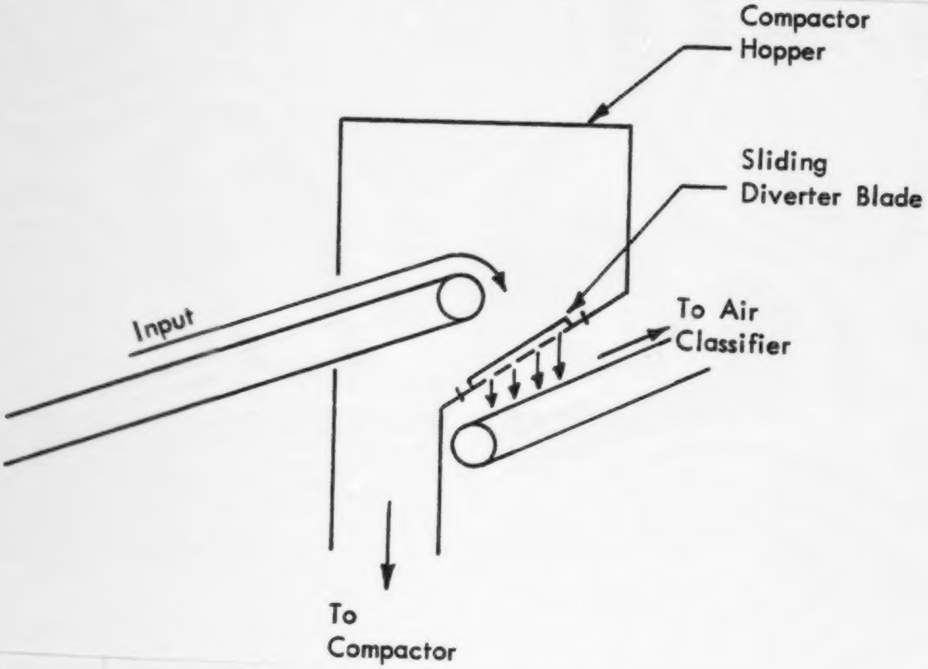
Compactor Hopper
Sliding Diverter Blade
Input
To Air Classifier
To Compactor

Figure 17. Diverter blade system - Baltimore County, Maryland.

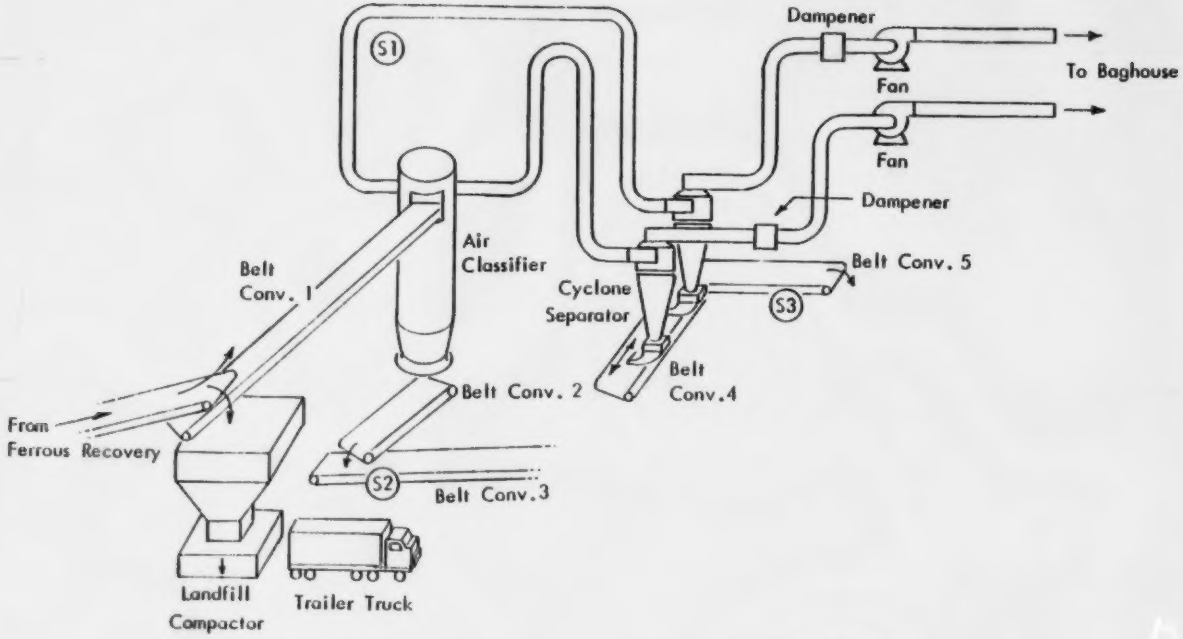
Dampener
To Baghouse
Fan
Fan
Dampener
S1
Air Classifier
Belt Conv. 1
Cyclone Separator
Belt Conv. 5
S3
Belt Conv.4
Belt Conv. 2
From Ferrous Recovery
S2
Belt Conv.3
Landfill Compactor
Trailer Truck

Figure 18. Air classifier system - Baltimore County, Maryland.

A diagram of the air classifier unit is shown in Figure 19. During operation, shredded MSW, less the ferrous metal removed by the magnetic separator system, enters the air classifier through an inner sleeve. Heavy and clumped material is dropped onto a cone to facilitate dispersement throughout the air classifier column. Dispersion is accomplished by cone geometry with air jets located around the perimeter of the cone.

The heavy material not caught in the airstream falls to the bottom of the air classifier. The light material caught in the airstream and is carried with the air into the cyclones. The material drops out of the air in the cyclone and passes out of the rotary air locks at the bottom of the cyclone. Light material dispersed through the rotary air lock is conveyed to a rotating trommel where grit and other solids are dropped out of the lights, which leaves predominantly paper and plastic.

Four fans which contribute to the total airflow in the air classifier system are shown schematically in Figure 20. The fans designated "east" and "west" supply the main airflow. The inlet ducts for these two fans are equipped with shutter-type dampers for control of the airflow rate. The cone air fan supplies the air to the cone suspended in the air classifier. The cone air is intended to induce turbulence in the separation zone and to fluidize the solid particles. For dust control, the air from the east and west fans exhausts into the baghouse.

Design Performance

The purpose of the Baltimore County air classifier system is to separate the bulk of the combustible organic fraction (e.g., paper, plastic, and wood waste) from the shredded municipal waste which is nominally less than 15 cm (6 in.) in size, leaving a heavy fraction consisting mainly of the metal and glass rich portions. The air classifier system design includes one air classifier, associated fans and motors, cyclones, discharge conveyors, connecting duct work, and electric wiring and sequence controls. The system was built to conform to appropriate Occupational Safety and Health Administration (OSHA), American Society for Testing and Materials (ASTM), and National Electric Code (NEC) standards and specifications, and all components were selected or designed for heavy duty use.

The air classifier was designed to continuously separate 63.5 Mg/h (70 ton/h) of nominal 15-cm (6-in.) shredded MSW into light and heavy fractions.

The air classifier system must be able to handle shredded MSW, with surges of 1.3 times the design rate for periods up to 5 minutes. Shredded MSW consists of residential and commercial trash or garbage including a variety of constituents. The amount of each constituent as a percentage of total received at the shredder input varies with each load received. Relatively larger variances occur between days of the week and between seasons.

Fig

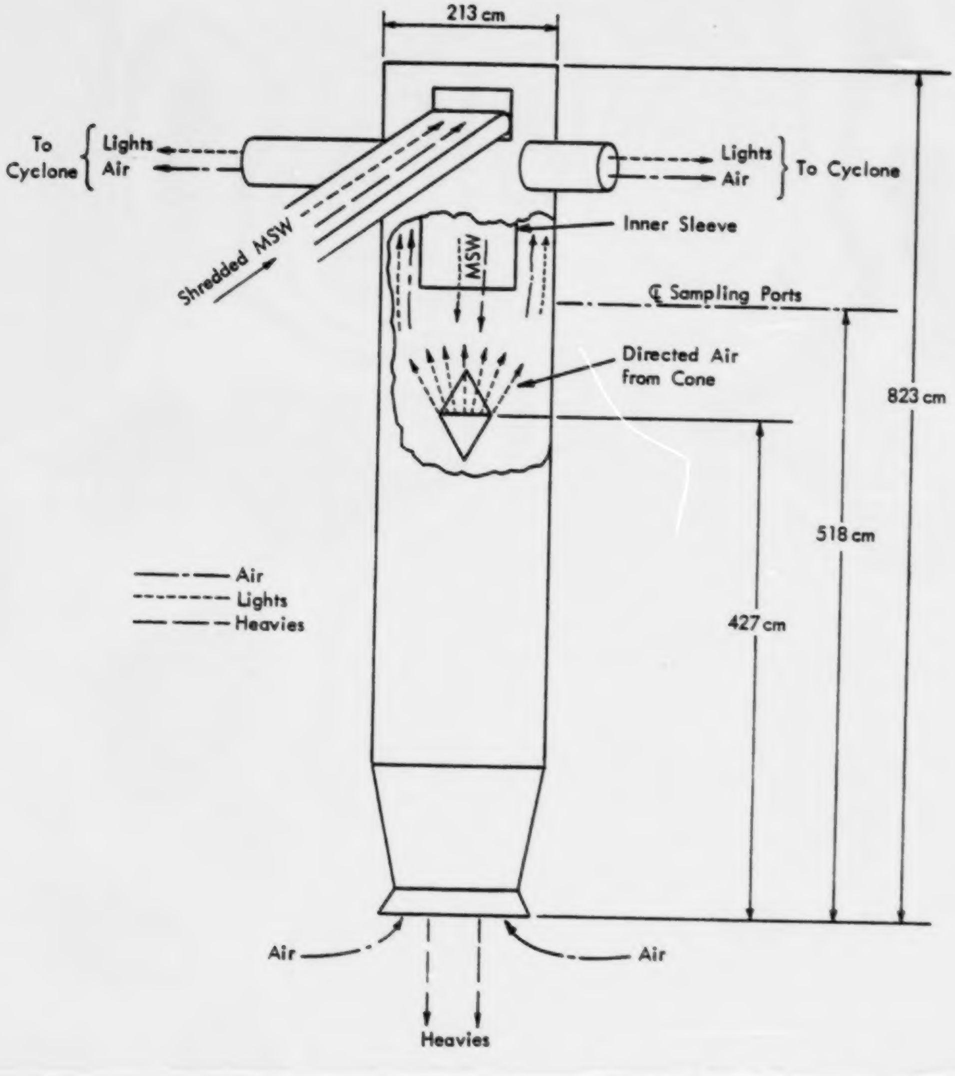
213 cm
To Cyclone
Lights
Air
Lights
Air
To Cyclone
Shredded MSW
Inner Sleeve
MSW
℄ Sampling Ports
Directed Air from Cone
823 cm
518 cm
427 cm
Air
Lights
Heavies
Air
Air
Heavies

Figure 19. Air classifier details - Baltimore County, Maryland.

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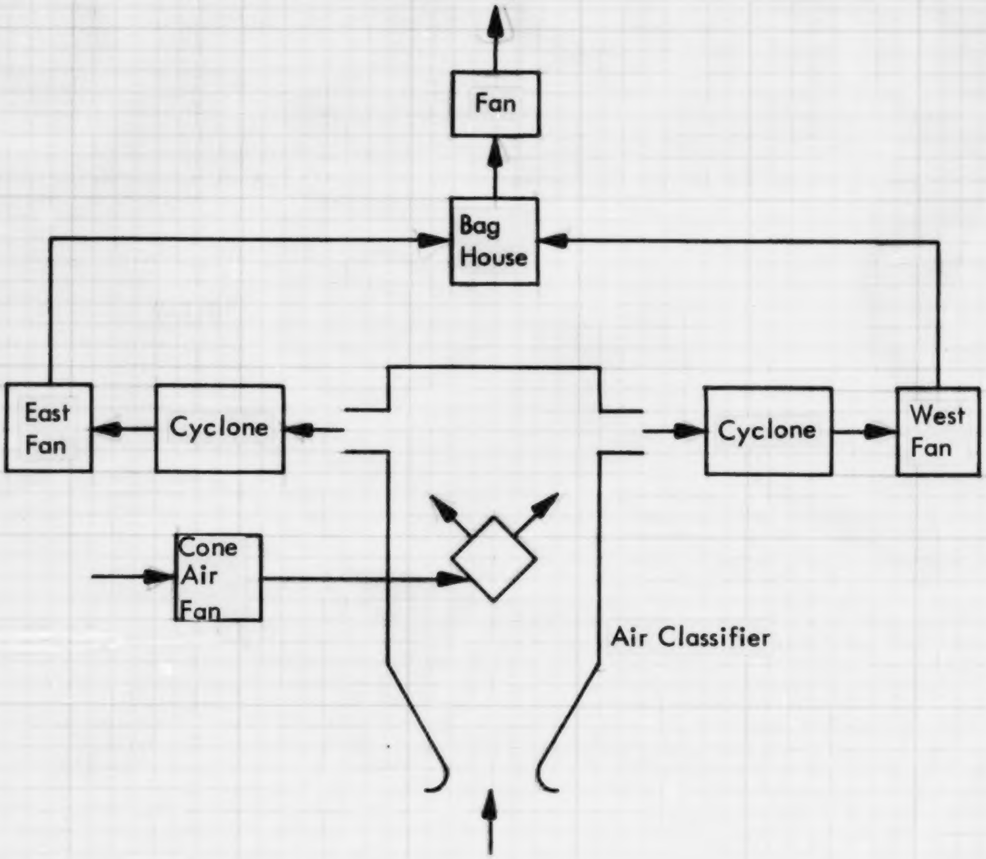
Fan
Bag House
East Fan
Cyclone
Cyclone
West Fan
Cone Air Fan
Air Classifier

Figure 20. Air classifier airflow diagram - Baltimore County, Maryland.

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The air classifier is designed to separate MSW into a combustible organic fraction (i.e., paper, plastic, wood waste, etc.) and a heavy fraction consisting mainly of metal and glass and relatively free of putrescibles. The heavy fraction is to contain no more than 10% of the combustible organic fraction. Air released to the atmosphere from the air classifier system is to meet specified air pollution control regulations. The equipment is designed and constructed to operate over an ambient temperature range of -10°F to 125°F in a dust-laden environment.

Operating Experience

Television monitoring of air classifier input and output streams was excellent. However, monitoring of the infeed belt did not provide the equipment operator with a depth or volume reference. In fact, the view shown on the monitor could be deceptive. Additional instruments such as belt scales, depth indicators, and belt velocity indicators would be helpful.

The diverter gate which was supposed to proportion part of the feed to the air classifier caused fluctuations of the shredded refuse infeed to the air classifier; this did not allow the unit to operate in a steady state mode.

Economic Data

The approximate uninstalled equipment cost of the Baltimore County unit was $250,000 in 1976. The cost of the installation was approximately $60,000 in the same year, bringing the total installed cost to $310,000 for the air classifier. These costs were not broken down into equipment component and labor costs. In addition, no values were available for air classifier system maintenance costs. The per unit operating capacity costs based on a design capacity of 63.5 Mg/h were $4,882/Mg/h ($4,429/ton/h).

Results of Performance Tests

As the first step in conducting the tests, conveyor speeds for the light and heavy fractions were measured. Next, indicator materials were injected into the refuse input flow stream to show the relative positions of the lights and heavies on their respective output belts. Once these positions were located, simultaneous samples of lights and heavies could be collected from the same input. The sampling point for the light material was on the conveyor feeding the trommel (point S3, Figure 18), and the sampling point for the heavies was on the second belt out of the air classifier (point S2, Figure 18).

The material flow rate to the air classifier at Baltimore County was controlled by setting the diverter blade which transfers the shredded MSW to the air classifier input belt (see Figure 17). The amount of material on the input conveyor was observed by a member of the project field test crew. When the burden on the conveyor looked appropriate, the observer signaled to the system operator via closed circuit television. The system operator then closed the diverter blade and stopped the conveyor system. Material was taken from a measured length along each conveyor and placed in plastic bags. These samples were then weighed. The length and weight of the samples and the speed of the respective belts being known, the flow rates were calculated for the light and heavy fractions. Input feed to the air classifier was calculated by adding output rates for the light and heavy fractions. The weight percentage of material reporting to the light fraction was calculated and plotted as a function of the input feed rate and used as a guide in determining the appropriate feed rate for the next test run. The above procedure was repeated until runs were made at all airflows and input feed rates of interest. Samples from the conveyor belts were taken at each setting of airflow rate and at each input feed condition.

The airflow rates through the east and west main fans were changed by opening or closing the dampers in the fan inlet ducts. The total airflow through the air classification system was determined by adding the airflow calculated from pitot tube traverses made in the inlet ducts for both main fans at each damper setting. Total pressure in each fan was also measured. In addition, the total pressure in the outlet duct and the airflow in the outlet duct of the cone air fan were determined.

The prime movers in the Baltimore air classifier system which consumed energy were four fan motors and two cyclone air lock motors.

Data obtained during the performance test are included in Tables C-1 through C-9 in Appendix C.

Concentration factors for paper plus plastic and metal at each input MSW flow rate and each airflow are shown in Table 3, which clearly shows that the air classifier concentrates paper and plastic as well as aluminum and ferrous materials. For paper and plastic, concentration factors ranged from a low of 1.06 to a high of 1.38. The lowest and highest concentration factors were obtained at the lowest airflow rate. The lowest average concentration factor was obtained at the middle airflow rate and the highest at the highest airflow rate. There does not appear to be a trend of concentration factor versus input feed rate at any of the three airflow rates tested.

Concentration factors obtained for aluminum plus ferrous materials were higher than the factors obtained for paper plus plastic. The concentration factors for the aluminum and ferrous materials ranged from 1.67 to 7.29. The lowest factor was obtained at the highest airflow rate, whereas the highest factor was obtained at the middle airflow rate. The highest concentration factors were obtained at the lowest infeed rates at each of the three airflows. The reason for this occurrence can be attributed to a low solids loading in the air column within the air classifier. A low solids loading offers less chance for interference between metal and the paper and plastic than does the higher solids loading. Interference between paper and metal can be expected to promote carry-over of metal with the paper and plastic. The lowest average concentration factor was obtained at the highest airflow rate and the highest at the middle airflow rate; this occurrence is opposite that for paper plus plastic.

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TABLE 3. CONCENTRATION FACTORS FOR VERTICAL CYLINDRICAL AIR CLASSIFIER WITH DISPERSION CONE - BALTIMORE, MARYLAND

Feed rate Mg/h	Factors at airflow of 28.11 m^3/s	Feed rate Mg/h	Factors at airflow of 31.81 m^3/s	Feed rate Mg/h	Factors at airflow of 38.46 m^3/s
		Paper and Plastic			
4.52	1.19	10.29	1.12	19.01	1.15
6.19	1.13	32.10	1.19	23.11	1.26
21.68	1.17	38.08	1.17	53.09	1.14
35.59	1.06	66.98	1.09	55.45	1.36
39.40	1.38	96.38	1.22	90.16	1.36
				96.08	1.21
Average	1.19	Average	1.16	Average	1.25
		Ferrous and Aluminum Materials			
4.52	3.79	10.29	7.29	19.01	6.93
6.19	3.70	32.10	4.76	23.11	2.81
21.68	3.04	38.08	3.96	53.09	1.67
35.59	1.83	66.98	3.43	55.45	1.98
39.40	2.36	96.38	2.62	90.16	1.76
				96.07	1.75
Average	2.94	Average	4.41	Average	2.82

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The ability of the air classifier system to handle refuse for each air flow is shown in Figure 21. A plot of the light fraction production versus the infeed rate to the air classifier is given in these figures. The data for each airflow rate showed a uniform increase in the production of lights with infeed rate, an apparent transition zone, and then a continued increase of production of lights at a lower rate as the infeed rate is increased. Onset of the transition zone appeared to be at infeed rates of 10 to 15 Mg/h of the lowest airflow rate, 18 to 25 Mg/h for the middle airflow rate, and 65 to 75 Mg/h for the highest air flow rate. The transition zone at the highest airflow rate was near the designed process rate of 64 Mg/h for the air classifier system.

Electrical power requirements for the system are given in Appendix Table C-9. As expected, the total electrical power requirements increased with the airflow. Power requirements were 315 kW at the lowest airflow, 325 kW at the middle airflow, and 355.8 kW at the highest airflow.

The overall plant was designed to operate at the input feed rate of 91 Mg/h (100 ton/h). A review of the performance curves on Figure 21 indicates that the highest airflow rate is preferred. Specific energy consumption of the air classifier at the designed infeed rate of 64 Mg/h and the highest flow rate is 5.59 kWh/Mg (5.08 kWh/ton). The ash content for the light and heavy fractions is given on Table C-1 in Appendix C. The ash content of the light fraction produced with this air classifier ranged from a low of 16% to a high of 35.4%. These values clearly indicate that this air classifier carried over a sizable quantity of noncombustibles along with the light fraction. The relatively large quantity of material that passes through the smallest sieve (see Table C-6) and the substantial weight in the aluminum, ferrous materials, and the other categories of the sample composition (see Table C-7) tend to support the statement that substantial quantities of noncombustibles are carried over with the lights. Much of this noncombustible carry-over is removed by a trommel screen located downstream from the air classifier (see Figure 16).

Ash content in the heavy fraction was much larger than in the light fraction (see Table C-1 in Appendix C). Ash content ranged from 32.2 to 74.3%.

Figure 22 shows LFC plotted against refuse infeed rate. LFC decreased slightly with feed rate for all three airflow rates. The high average LFC value was found at the lowest airflow rate and the lowest at the middle airflow rate. The greatest range of values was also at the middle airflow rate.

Figure 23 shows the yield of RDF versus infeed rate for each of the three airflows. RDF yield appeared to decline slowly at first and then rapidly with infeed rate. This trend was particularly noticeable in the highest airflow rate. Such a rapid decline in physical processes is often associated with a transition zone brought about by changing a process parameter. In this case the parameter is the infeed rate to the air classifier.

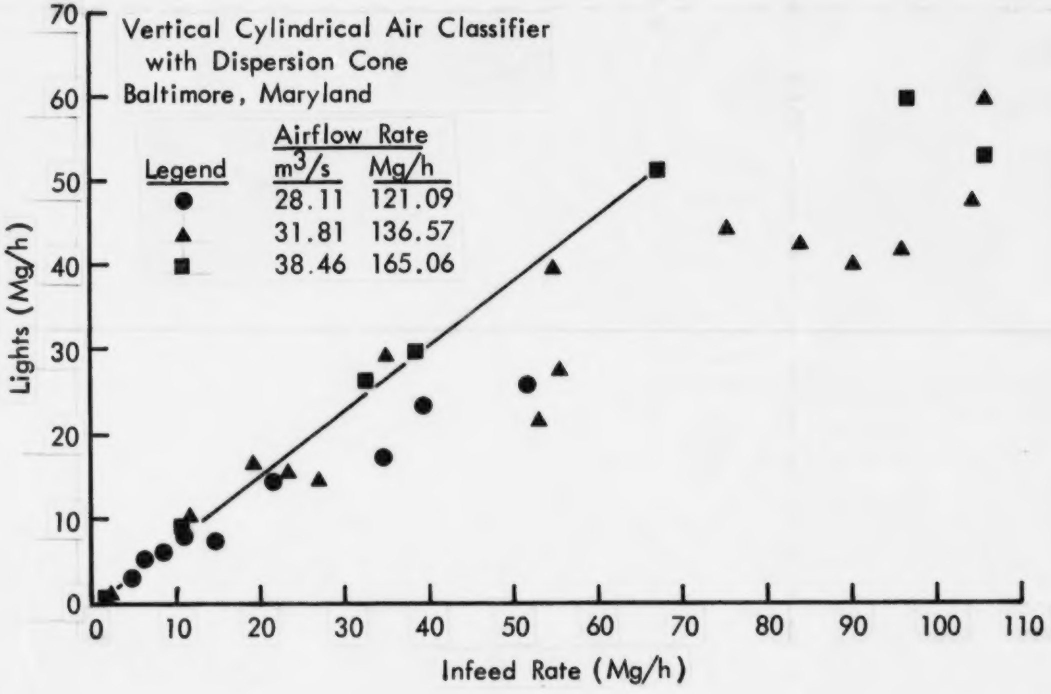

Figure 21. Lights production rate as a function of infeed rate - Baltimore, Maryland.

Fig

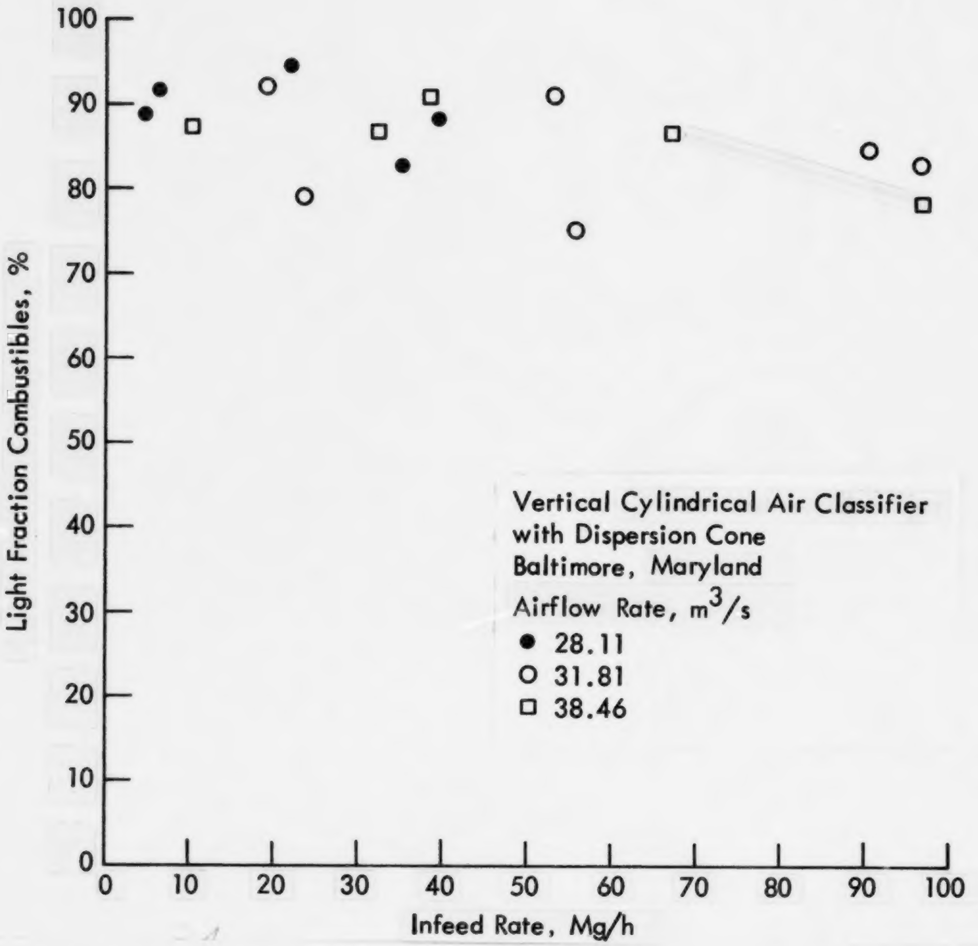

Figure 22. Light fraction combustibles versus infeed rate - Baltimore, Maryland.

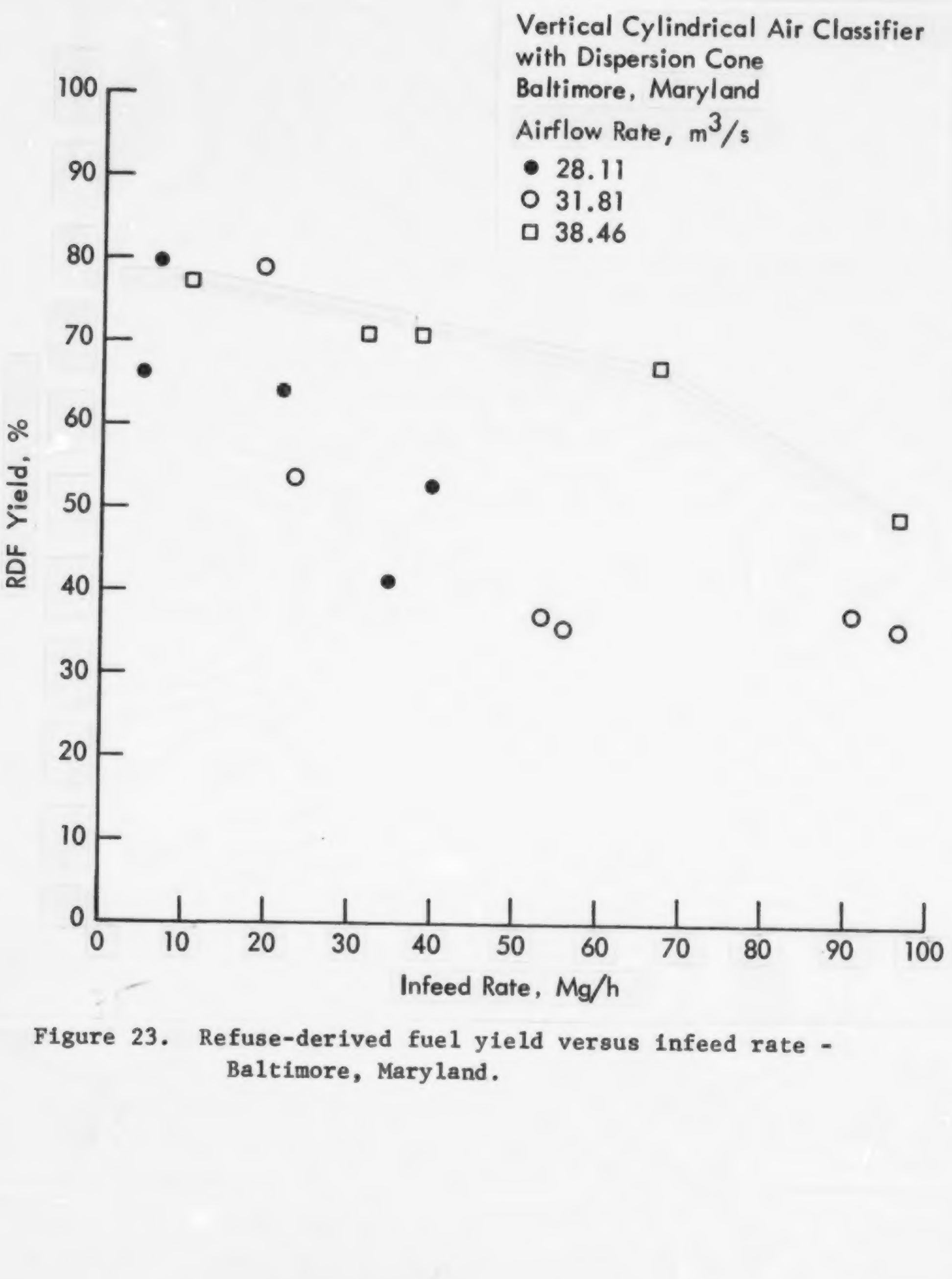

Figure 23. Refuse-derived fuel yield versus infeed rate - Baltimore, Maryland.

A plot of paper and plastic in the heavies versus infeed rate to airflow rate weight ratio is given in Figure 24. At the middle and highest airflow rate the percentage of paper and plastic in the heavies tended to increase with increasing infeed rate to airflow rate ratio. At the low airflow rate the percentage of paper and plastic was generally high but too variable to draw conclusions concerning a trend. The infeed rate to airflow rate ratios at the rated capacity of the air classifier (64 Mg/h) for the low, middle, and high airflow rates were 0.75, 0.66, and 0.55, respectively.

A plot of percentage of ash from lights versus infeed rate to airflow rate weight ratio is given in Figure 25. The level of ash content at all airflow rates shows considerable noncombustibles were carried over with the lights at each infeed rate.

A plot of percentage of lights produced versus infeed rate to airflow rate weight ratio is shown in Figure 26. The best overall performance of the air classifier in separating lights from the infeed was realized at the highest airflow rate.

The average oven dry heating value for the eight samples analyzed for heating value was 12,025 kJ/kg for the lights and 8,188 kJ/kg for the heavies, a 31.9% difference. Therefore, light fraction energy recovery was higher than light fraction material weight recovery. Percentage of total energy contained in the infeed recovered by the air classifier in the light fraction varied between 90.9% and 45.6% and is plotted in Figure 27. The trend is that the higher percentage energy recoveries occur at the lower infeed flow rates and at the highest airflow rate.

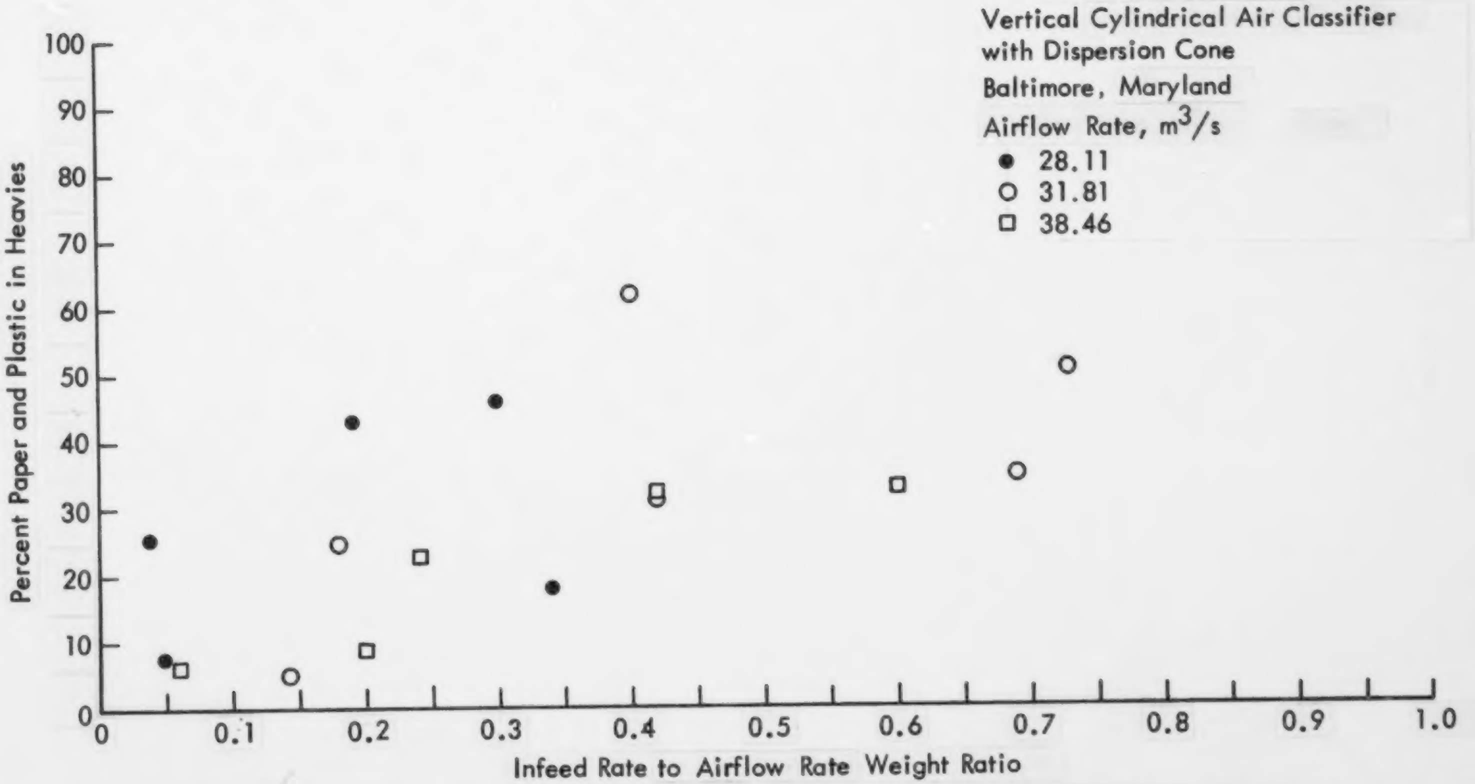

Figure 24. Percentage of paper and plastic in heavies versus solids to air weight ratio - Baltimore, Maryland.

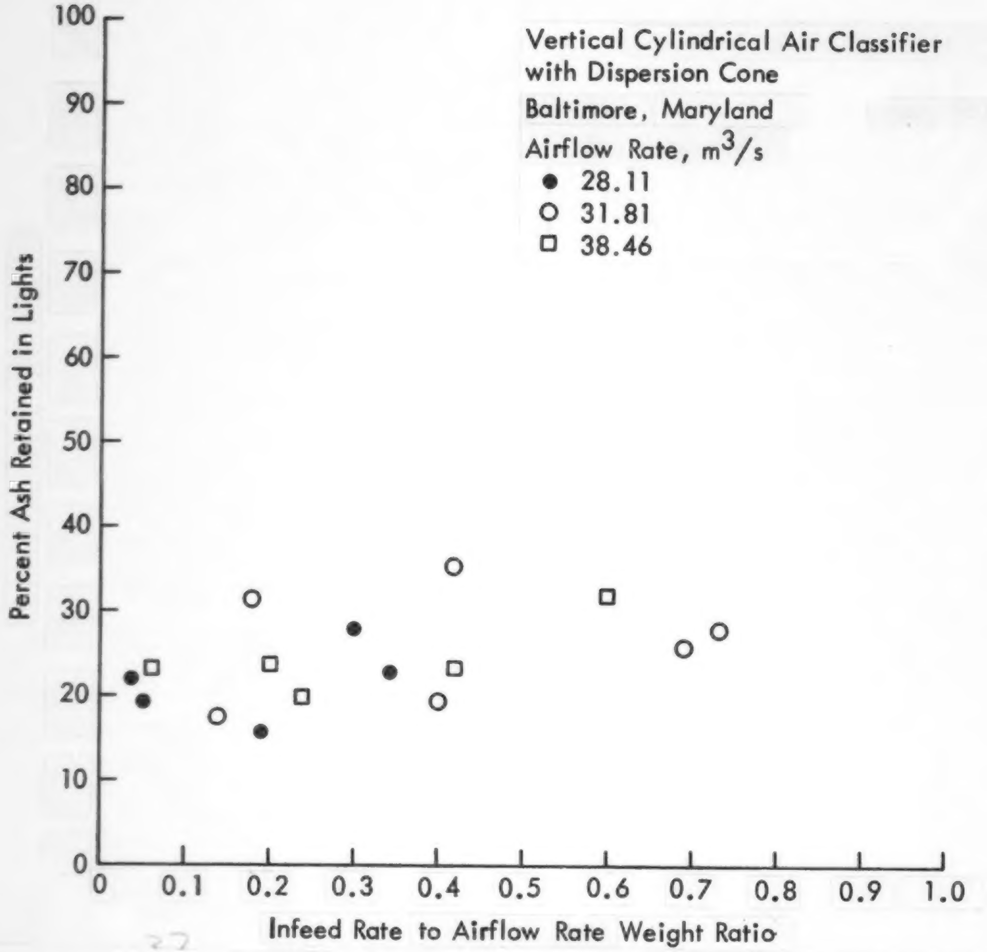

Figure 25. Percentage of ash retained in lights versus solids to air weight ratio - Baltimore, Maryland.

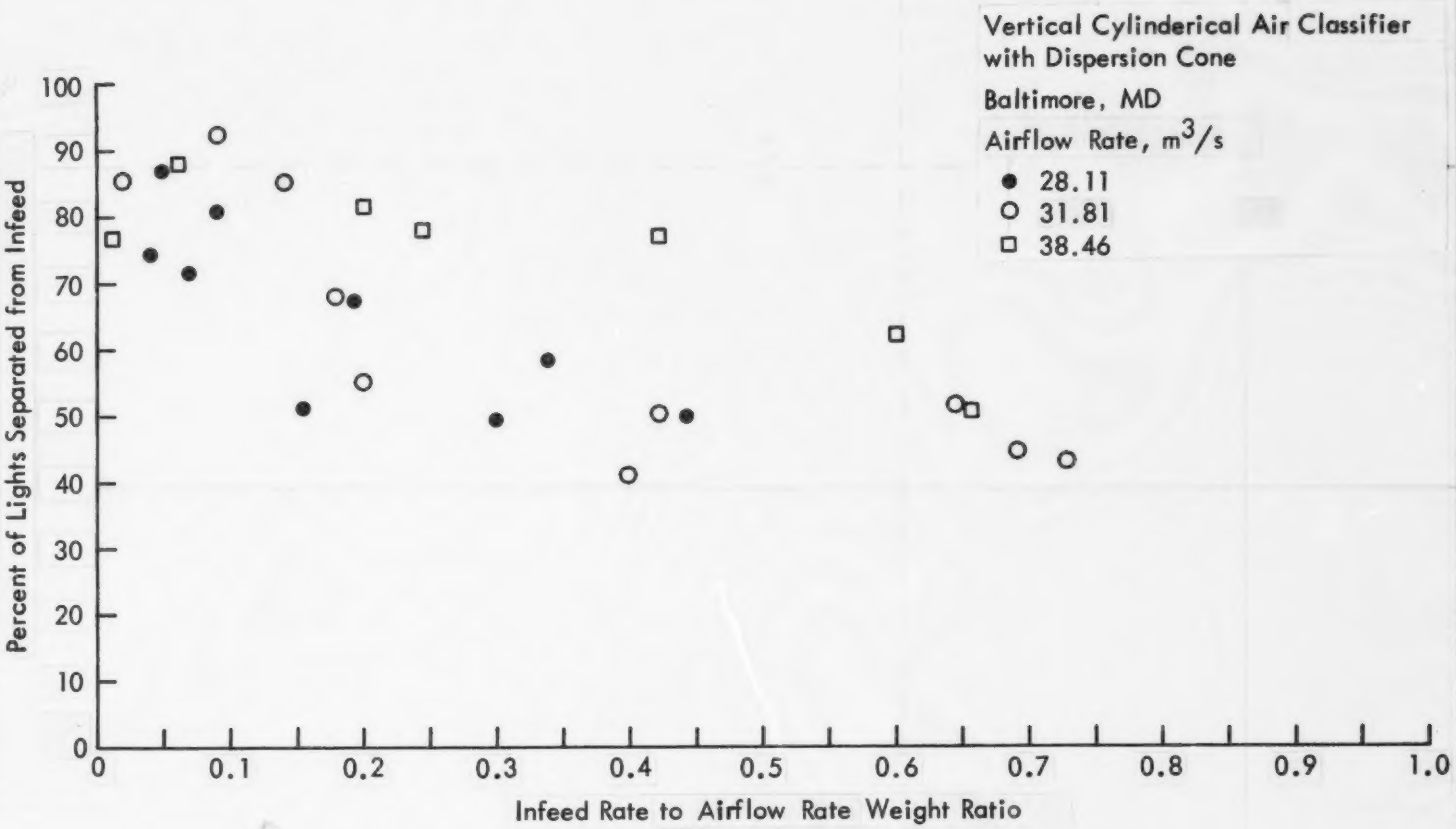

Figure 26. Percentage of infeed reporting to lights versus solids to air weight ratio - Baltimore, Maryland.

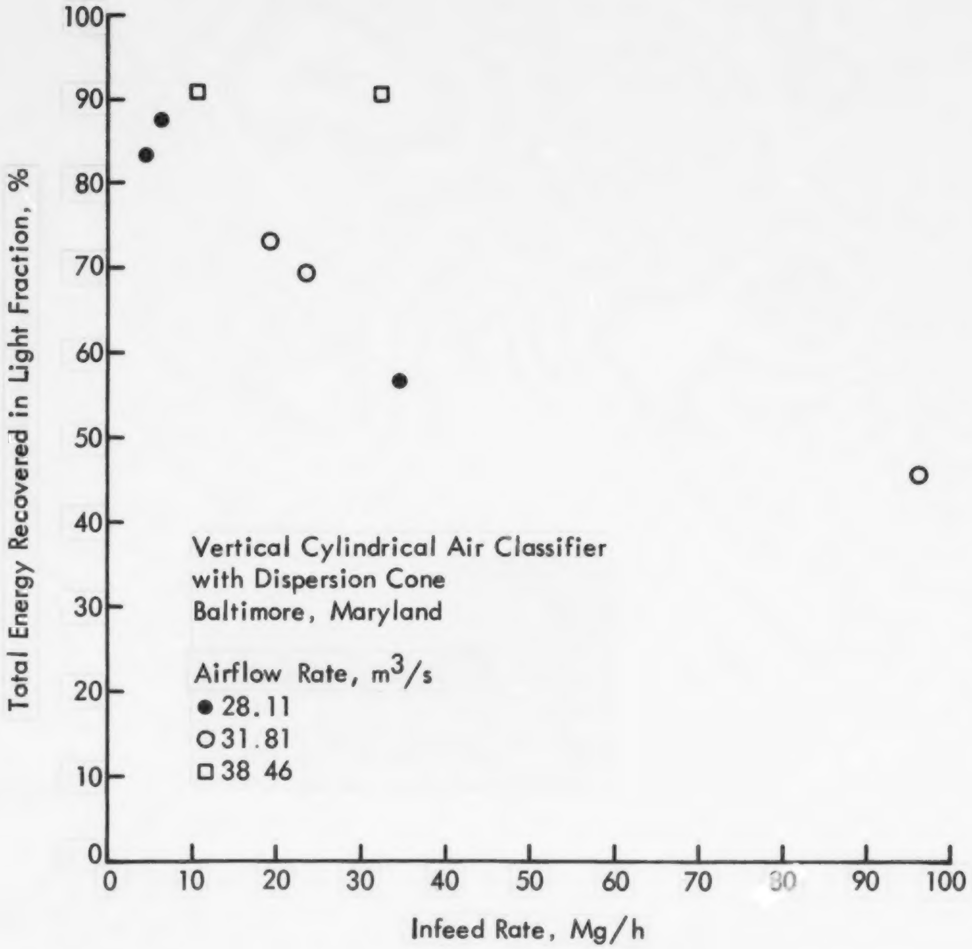

Figure 27. Energy recovery versus infeed rate - Baltimore, Maryland.

VERTICAL RECTANGULAR AIR CLASSIFIER--RICHMOND, CALIFORNIA

General Description of Refuse Plant

This plant is a pilot scale facility which belongs to the University of California, Berkeley. It is located at the Richmond Field Station. A schematic diagram of the overall system is shown in Figure 28. The plant was designed and constructed for testing solid waste processing equipment for unit operations in the 4-Mg/h range. Major components of the system include shredder, air classifier, cyclone, trommel, and magnetic separator. System operation is described in the following paragraphs by tracing MSW flow through the plant.

Raw refuse is dumped on the floor and then loaded into the shredder infeed hopper with a front-end loader. Shredded material is transported directly to the air classifier on a cleated pan conveyor. The infeed is split into light and heavy fractions by the air classifier. The light material flies with the air and is separated from the airstream in the cyclone located on the roof of the building. Light material passes through the air lock at the bottom of the cyclone and then enters the trommel where glass, grit, and other high density materials are removed as undersize. This material is collected for transporting to a landfill. Material passing through the trommel as oversize is collected for fuel. The heavy material falls out the bottom of the air classifier onto a conveyor which carries it under a magnetic separator for removal of ferrous material. The ferrous material is collected for subsequent sale to a scrap dealer. The nonferrous material is rejected and goes to a collection point for transport to a landfill.

Air Classifier System

The air classifier system is shown in Figure 29. The system as defined for this evaluation consists of the air classifier, fan, and cyclone separator with an integral air lock.

The air classifier was constructed for test purposes; and, therefore, it was built of wood with a plexiglass side panel to facilitate observation of refuse action inside the unit. A damper installed on the output side of the fan provides the means of varying airflow through the air classifier system.

Most of the air pulled through the system by the fan enters the bottom of the air classifier; a small amount enters the system through a material infeed opening. Air travels upward from the air classifier into the cyclone. The air is then ducted to the fan and exhausts from the system through the damper.

Design Performance and Operating Experience

The air classifier system was designed for use in a pilot plant setup. Consequently, the air classifier proper was designed and constructed so that the cross-section could be adjusted. The wood and plexiglass construction

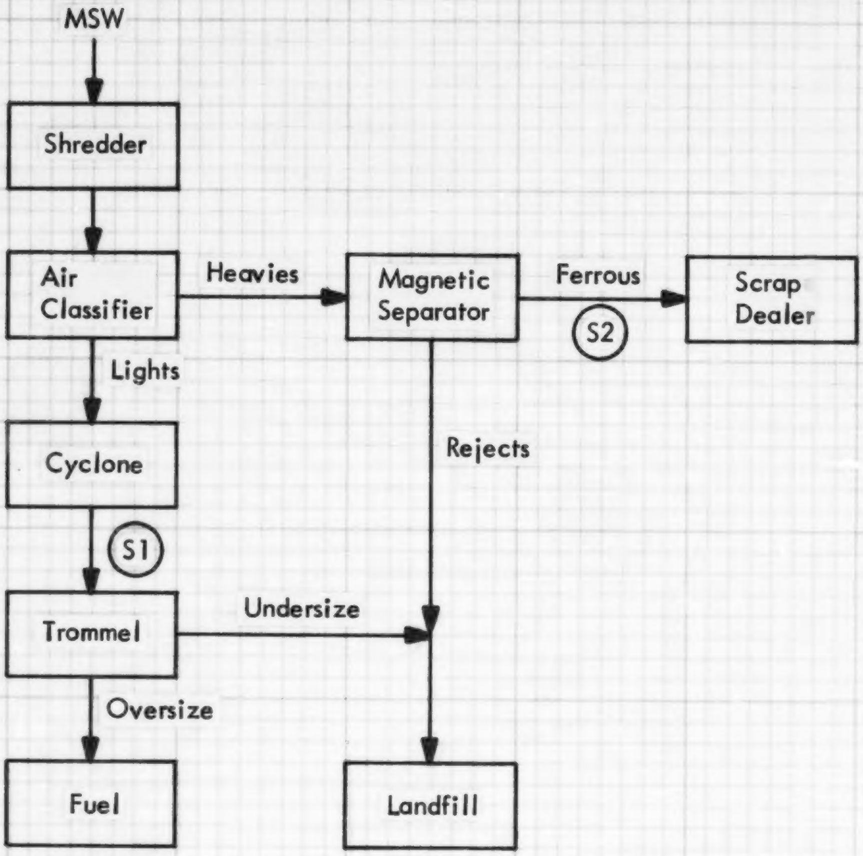
MSW
Shredder
Air Classifier
Heavies
Magnetic Separator
Ferrous
Scrap Dealer
S2
Lights
Cyclone
Rejects
S1
Trommel
Undersize
Oversize
Fuel
Landfill

Figure 28. MSW system flow diagram - Richmond, California.

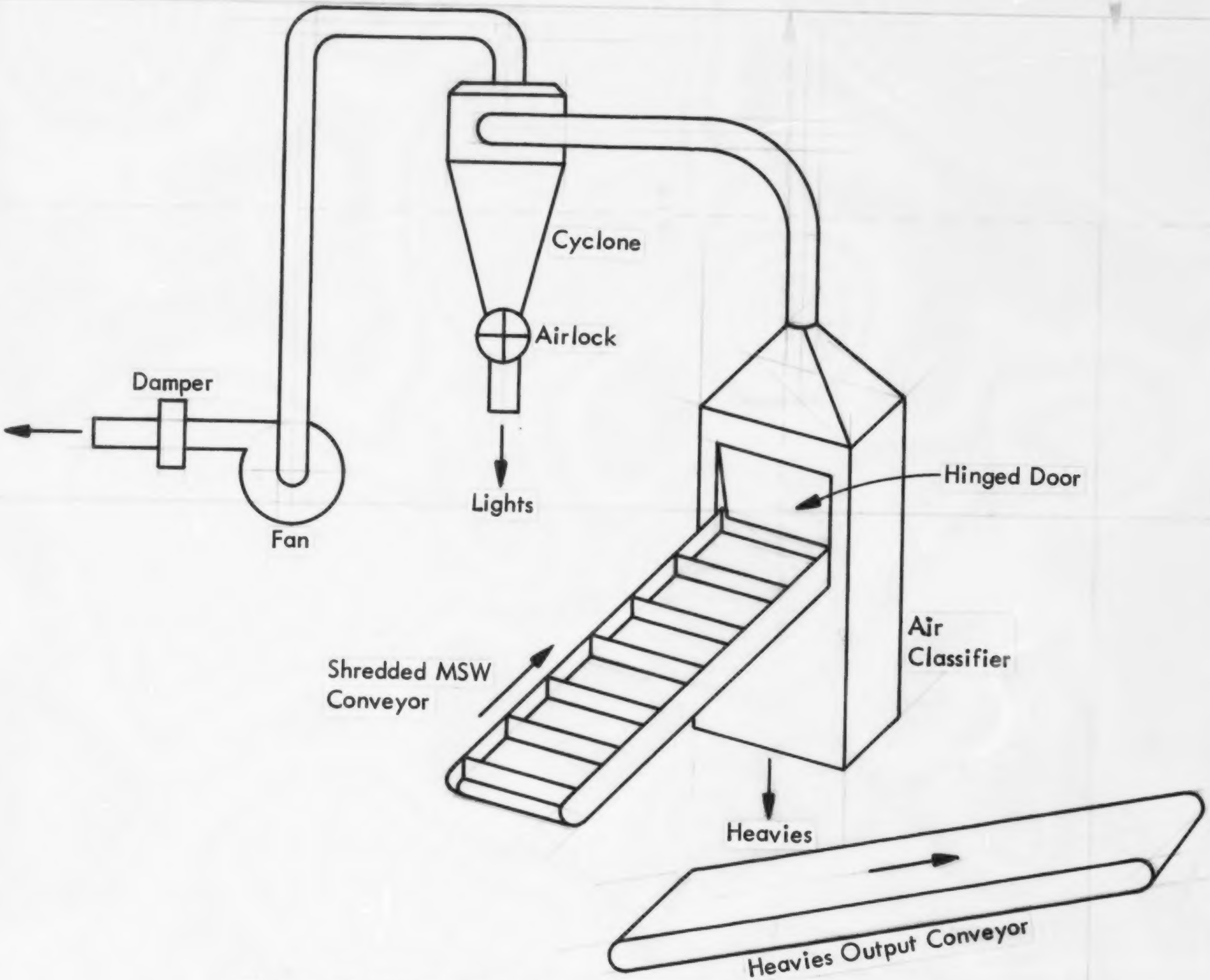
Cyclone
Airlock
Damper
Lights
Fan
Hinged Door
Air Classifier
Shredded MSW Conveyor
Heavies
Heavies Output Conveyor

Figure 29. Air classifier system - Richmond, California.

of the air classifier allow the configuration to be modified at relatively little expense. The plexiglass side permits visual observation of refuse within the air classifier. The system was designed to handle refuse at 4 Mg/h.

Operating experience has shown that the air classifier system was able to handle refuse at rates above the design value. Material action within the air classifier can readily be observed through the plexiglass side. Some air leakage through the infeed hinged door was evident. The effect of this somewhat variable leakage on air classifier operation is unknown.

Economic Data

Neither engineering design costs nor operation and maintenance costs were available. Capital costs for the year 1976 are given in Table 4. The capital cost, based on operating at designed capacity, was $2,438/Mg/h.

TABLE 4. ESTIMATED COSTS FOR VERTICAL RECTANGULAR AIR CLASSIFIER - RICHMOND, CALIFORNIA

Item (installed in 1976)	Cost ($)
Feed gate	200
Air classifier materials plus labor	3,800
Cyclone	900
Cyclone air lock and motor	300
Blower	800
Damper	100
Control panel and motor starter	700
Ducting	200
Electrical installation	500
Material installation	
Crane operator	250
Other	2,000
Total[a]	9,750

[a] Excludes engineering fees and site preparation costs.

Results of Performance Tests

Material infeed to the air classifier was controlled by leveling the burden on the infeed conveyor to a predetermined depth. The depth required to obtain a specific flow rate was judged from experience. Relative travel time between the lights and heavies sampling points was established with the use of indicator materials. Thus, the time lag was adjusted between collecting samples at the heavy and light sampling points so that both light and heavy samples would come from the same infeed material. Sampling points for the lights and heavies are indicated as S1 and S2, respectively, in Figure 28.

The heavy material falls directly out of the air classifier onto a short conveyor which empties into the sample collection container, and the light material is swept upward from the air classifier, through ducting, down through the cyclone, and out the air lock.

During performance tests stopwatches were used to time the delay and the duration of sampling. The magnetic separator was turned off during sampling runs, thus allowing all the material dropping out of the classifier to be collected in a sampling container. The floor around the container was swept clean so that any material which missed the container could be recovered. The light material was sampled at the output of the cyclone air lock by placing a barrel directly below the opening. After collection, both the heavies and lights samples were weighed and their flow rates calculated. The infeed rate was determined by adding the flow rates of the lights and the heavies.

Three airflow rates were used in the performance testing of the Richmond, California, air classifier. The flow rates were set by positioning a damper in the duct on the discharge side of the fan. Average airflow rates were determined from data collected while making pitot tube traverses of the inlet and outlet ducts of the fan. Total duct pressure was measured immediately after the airflow data were taken. In addition, the velocity profile inside the air classifier was determined. Data obtained during the performance tests are included in Tables D-1 through D-9 in Appendix D.

Concentration factors for paper plus plastic and metal at each input MSW flow rate and each airflow rate are shown in Table 5. This table shows that the air classifier concentrated paper and plastic as well as aluminum and ferrous materials. Paper and plastic concentration factors ranged from 1.04 to 1.42. Both the lowest and highest concentration factors were at the lowest airflow. Average concentration factors decreased with airflow rate. There does not appear to be a trend between concentration factors and MSW input feed rate.

Concentration factors obtained for aluminum plus ferrous materials ranged from 1.31 to 5.89. The lowest factor was obtained at the lowest airflow rate and the highest at the middle airflow rate. The lowest average concentration factor of 2.08 was found at the lowest airflow rate, and the highest average factor of 4.56 was found at the highest airflow rate; this occurrence is opposite that found for paper and plastic.

The ability of the air classifier system to handle refuse is shown in Figure 30. A plot of the light fraction versus infeed is shown in this figure. Data for each airflow rate showed a uniform increase in production of

TABLE 5. CONCENTRATION FACTORS FOR VERTICAL RECTANGULAR AIR CLASSIFIER - RICHMOND, CALIFORNIA

Feed rate Mg/h	Factors at airflow of 1.31 m^3/s	Feed rate Mg/h	Factors at airflow of 1.70 m^3/s	Feed rate Mg/h	Factors at airflow of 2.57 m^3/s
		Paper and Plastic			
0.13	1.42	0.12	1.18	0.57	1.22
0.35	1.30	0.43	1.17	0.62	1.21
0.93	1.32	0.67	1.16	2.12	1.11
1.57	1.11	0.82	1.20	2.37	1.13
2.43	1.38	1.47	1.26	4.92	1.15
6.22	1.04	4.01	1.20		
		5.67	1.09		
Average	1.26	Average	1.18	Average	1.16
		Ferrous and Aluminum Materials			
0.13	2.51	0.12	4.99	0.57	4.26
0.35	2.77	0.43	4.71	0.62	3.75
0.93	1.88	0.67	5.89	2.12	6.20
1.57	2.49	0.82	3.77	2.37	4.30
2.43	1.54	1.47	3.18	4.92	4.30
6.22	1.31	4.01	2.41		
		5.67	2.05		
Average	2.08	Average	3.86	Average	4.56

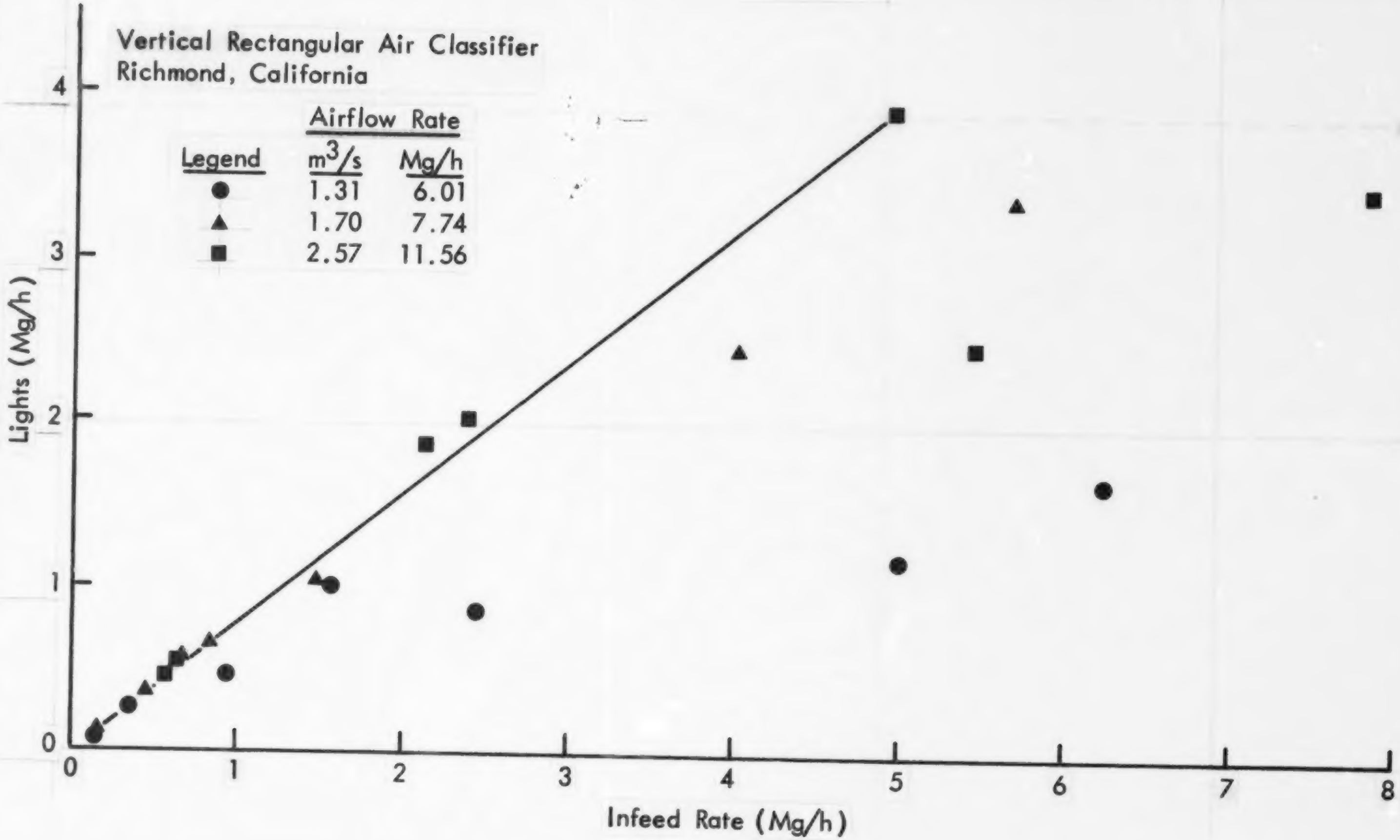

Figure 30. Lights production rate as a function of infeed rate - Richmond, California.

lights with infeed rate, an apparent transition zone, and then a continued increase of lights production but at a lower rate with further increase of infeed rate.

At the lowest airflow the transition zone appears to be above 1.5 Mg/h but less than 2.5 Mg/h; at the middle airflow rate, above 2.5 Mg/h but less than 3 Mg/h; and at the highest airflow rate, above 4.5 Mg/h but less than 5.5 Mg/h. The transition zone at the highest airflow rate is a little above the design shredded MSW infeed rate of 4 Mg/h.

Electrical power requirements for the fan and air lock are given in Table D-7 in Appendix D. A total of 10.1 kW was required at the lowest airflow rate, 12.6 kW at the middle, and 16.6 kW at the highest. For the highest airflow, the energy consumed during each hour of operation was 16.6 kWh. Operating at the designed infeed rate of 4 Mg/h and at the highest airflow rate, the specific energy consumption was 4.15 kWh/Mg.

Ash content for the light and heavy fractions is given in Table D-1 in Appendix D. The ash content of the light fraction produced with this air classifier ranged from a low of 11.5% to a high of 28.9%. These values indicate that this air classifier does carry over some noncombustibles along with the light fraction. The quantity of material that passed through the smallest sieve (see Table D-6) and the weight in the aluminum, ferrous, and "other" categories of the sample composition (see Table D-7) tend to support this finding. This quantity was high enough to suggest that the trommel unit is needed to eliminate or greatly reduce the quantity of noncombustibles in the RDF.

Ash content in the heavy fraction was generally much higher than in the light fraction (see Table D-1 in Appendix D). Ash content ranged from 38.5 to 91.3%. High ash content in the heavy fraction was expected because heavies in MSW are composed predominantly of metals and other noncombustibles.

Figure 31 shows LFC plotted against MSW infeed rate. The average LFC at the low, middle, and high flow rates was 93.9, 90.3, and 88.5%, respectively. LFC values tend to decrease slightly with refuse infeed rate at each airflow rate.

Figure 32 shows RDF yield versus infeed rate for each of three airflows. There was a general trend of RDF yield to increase with airflow rate. At the highest airflow rate, RDF yield tended to be level as infeed increased but then declined at the higher infeed rates. A similar trend could be noted for the middle and low airflow rates; however, the declines were seen at lower infeed rates and were more pronounced.

A plot of paper and plastic in the heavies versus infeed rate to airflow rate weight ratio is given in Figure 33. At the highest airflow rate the percentage of paper and plastic in the heavies tended to increase with increasing infeed rate to airflow rate ratio and to a relatively high level and then remain high. At the other two airflow rates the percentage of paper and plastic was generally high for all solid to air weight ratios investigated.

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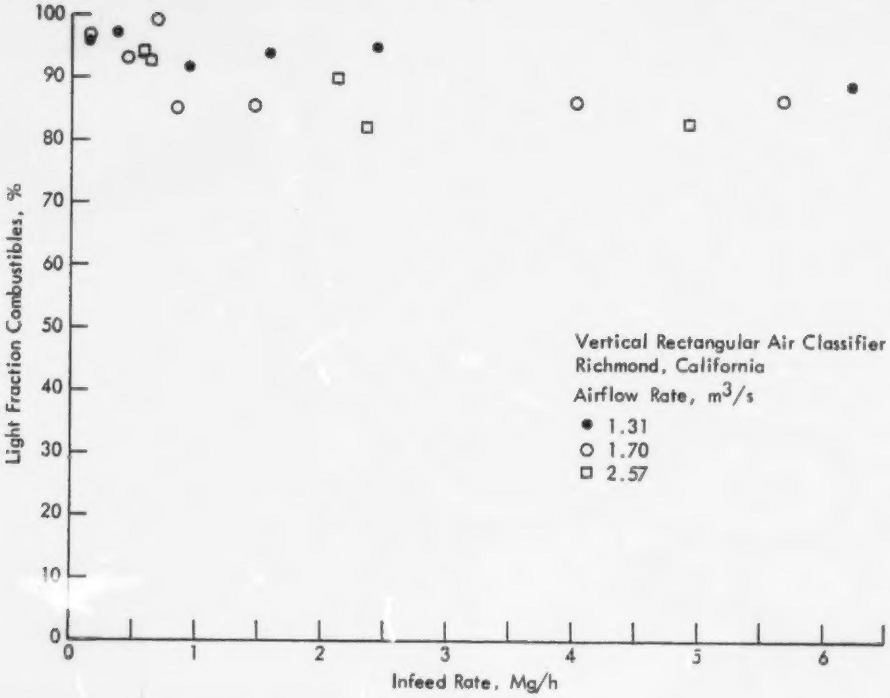

Figure 31. Light fraction combustibles versus infeed rate - Richmond, California.

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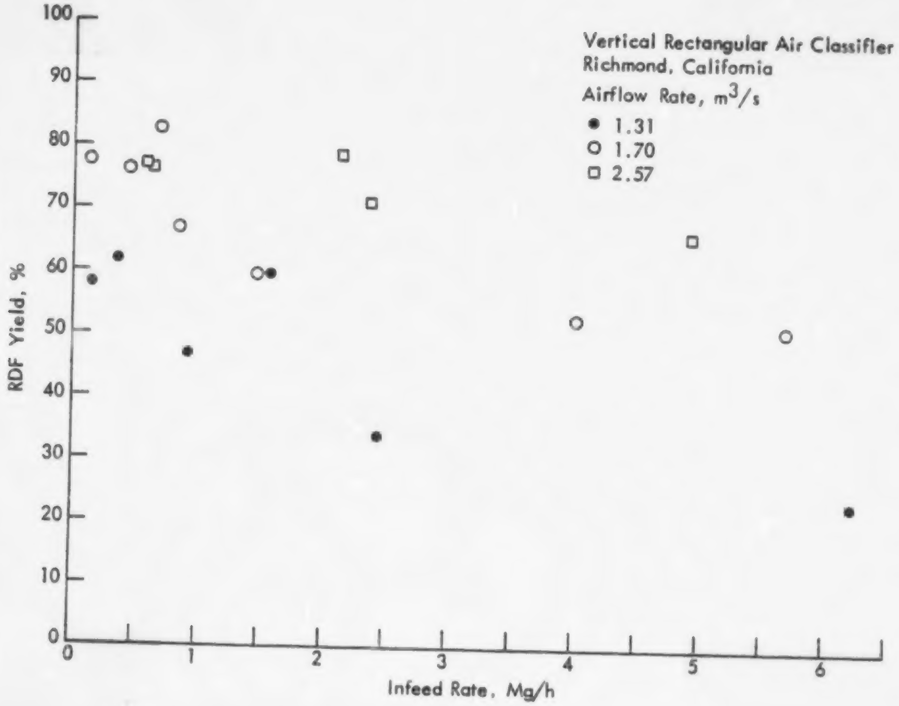

Figure 32. Refuse-derived fuel yield versus infeed rate - Richmond, California.

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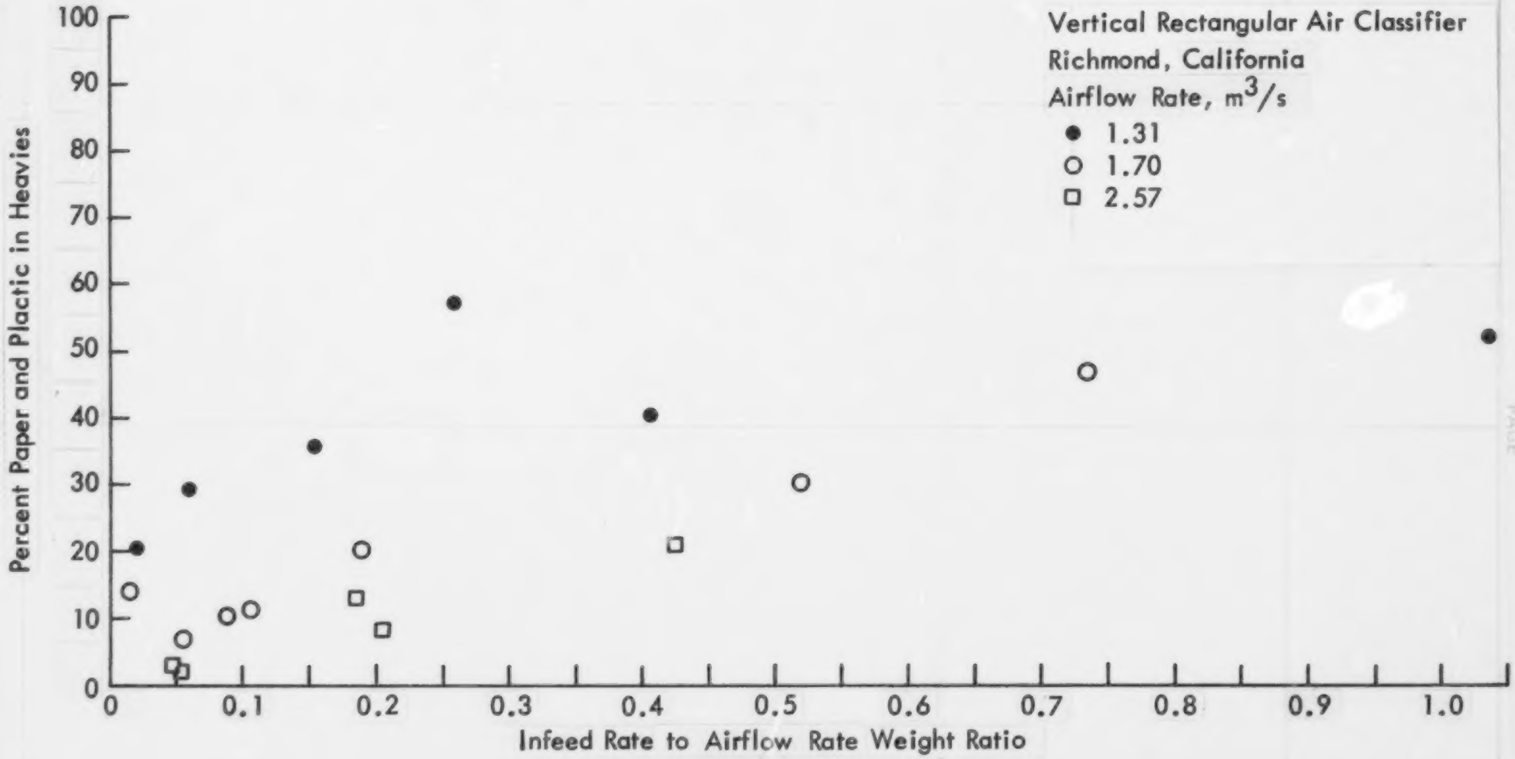

Figure 33. Percentage of paper and plastic in heavies versus solids to air weight ratio - Richmond, California.

The infeed rate to airflow rate ratios at the rated capacity of the air classifier (4 Mg/h) for the low, middle, and high airflow rates were 0.68, 0.52, and 0.35, respectively. When operating in the rated capacity range and below at either the highest or middle airflow rates, paper and plastic in the heavies was less than 20%, with one exception at 31%, whereas at the lowest airflow rate values ranged from 20 to 58%. On the basis of paper and plastic rejection to the heavies at infeed rates to the rated capacity range of the air classifier, the highest airflow rate is preferred.

A plot of percentage of ash from lights versus infeed rate to airflow rate weight ratio is given in Figure 34. The level of ash content at all airflow rates shows considerable noncombustibles were carried over with the lights at each infeed rate.

A plot percentage of lights produced versus infeed rate to airflow rate weight ratio is shown in Figure 35. The trend is for the highest production of lights up to the upper end of the rated capacity range of the air classifier to occur at the highest airflow rate.

The average oven dry heating value for the eight samples analyzed for heating value was 13,049 kJ/kg for the lights and 6,231 kJ/kg for the heavies, a 52.2% difference. Therefore light fraction energy recovery was higher than light fraction material weight recovery. Percentage of total energy contained in the infeed recovered by the air classifier in the light fraction varied between 97.6% and 51.8% and is plotted in Figure 36. The trend is that the higher percentage energy recoveries occur at the lower infeed flow rates and at the higher airflow rates.

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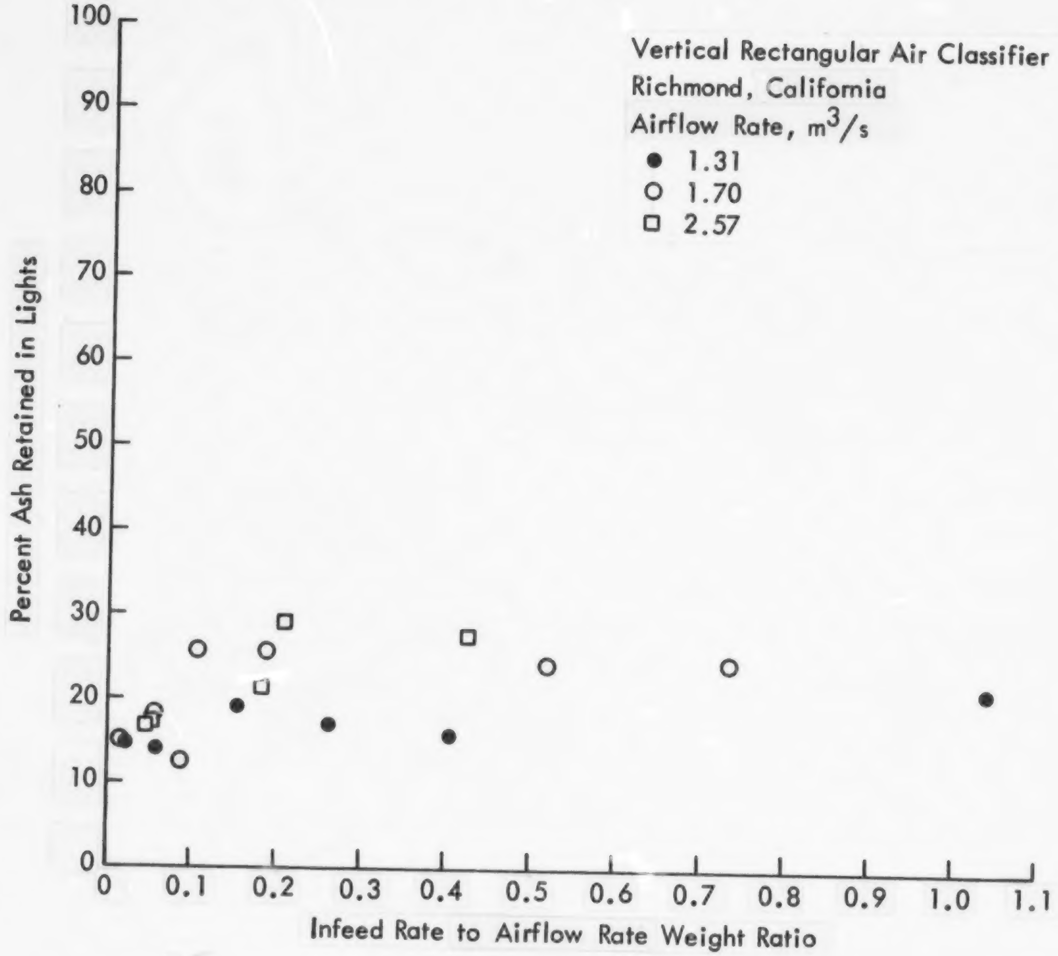

Figure 34. Percentage of ash retained in lights versus solids to air weight ratio - Richmond, California.

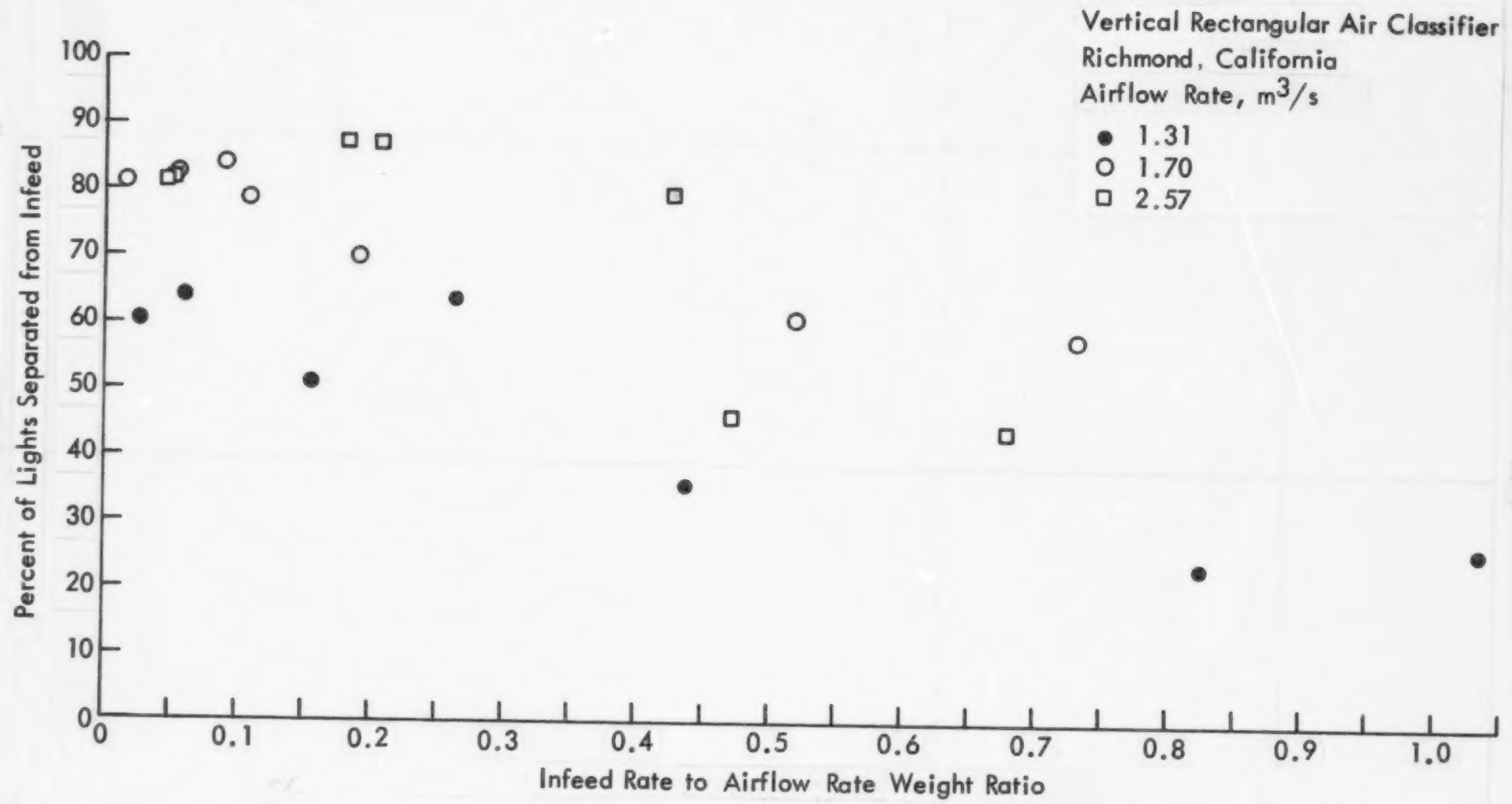

Figure 35. Percentage of infeed reporting to lights versus solids to air weight ratio - Richmond, California.

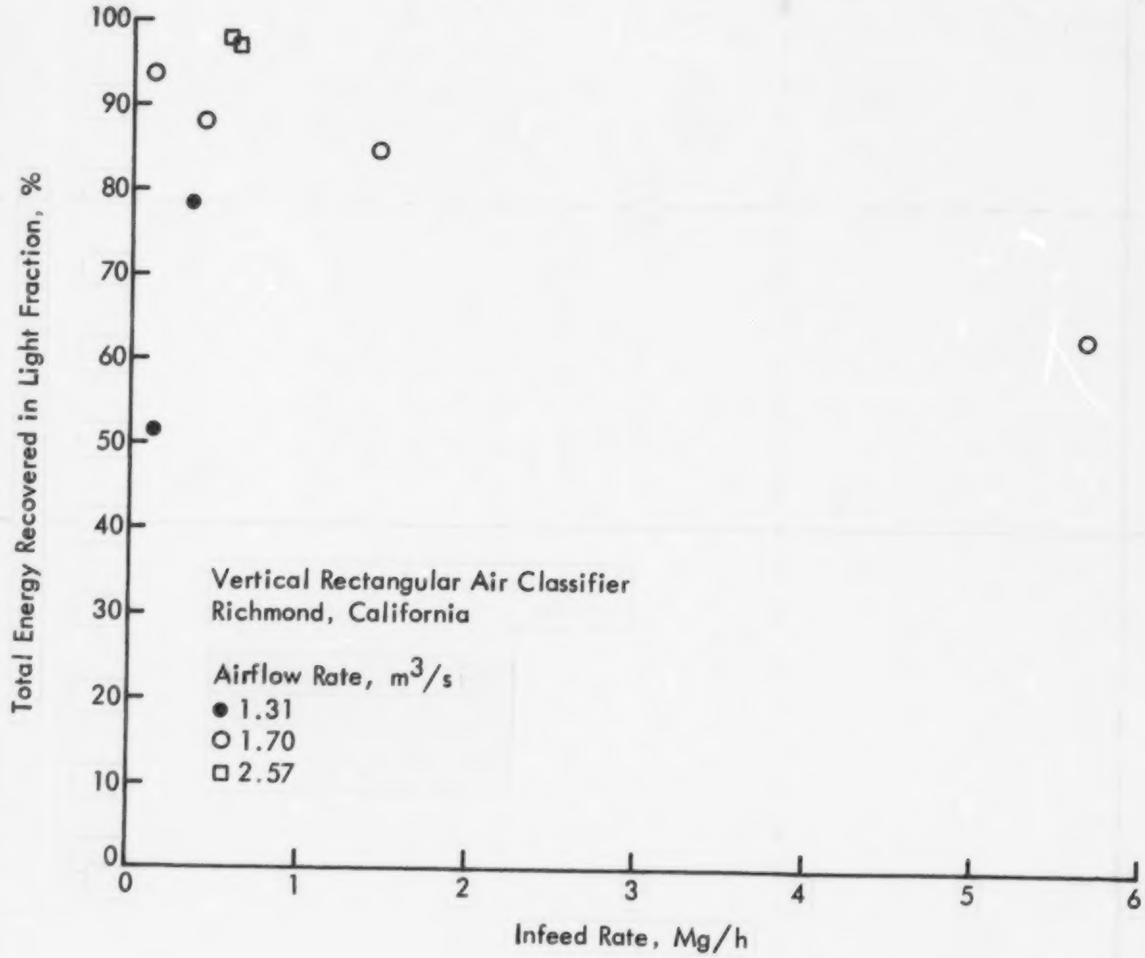

Figure 36. Energy recovery versus infeed rate - Richmond, California.

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MODIFIED VERTICAL RECTANGULAR AIR CLASSIFIER--AMES, IOWA

General Description of Refuse Plant

The Ames Solid Waste Recovery System is a continuously operating system that is processing municipal solid waste for use as a supplemental fuel in the existing steam generators of the Ames Municipal Power Plant. The total system consists of a nominal 136-Mg (150-ton) processing plant, a 454-Mg (500-ton) Atlas storage bin, and a pneumatic transport system. The processing plant incorporates two stages of shredding, ferrous and nonferrous metal recovery, and an air density separator.

The general plant is composed of the following subsystems:

- Tipping floor;
- Shredder system;
- ADS (air density separator) system (air classifier system);
- Reject bin;
- Ferrous metal separation system;
- Pneumatic conveying system; and
- Atlas bin.

A block diagram of the processing plant is shown in Figure 37. In operation, MSW is delivered to the tipping floor, which is 48 m by 32 m in size and has two entrances and exits. One entrance and exit is for commercial trucks, and the other is for private automobiles and pickup trucks. A front-end loader is used to push the MSW onto the infeed conveyor which feeds the first shredder. Output from the first shredder is fed onto a belt conveyor and passes under the primary ferrous material separator. After further secondary separation, the ferrous is transported to a truck storage unit while the nonmagnet material is returned to the stream of nonferrous material and enters a disc screen unit. Overs from this screen go to the second shredder. Unders pass to a second disc screen. Overs go to the surge bin, and unders go to the reject bin and subsequently to a landfill. Material from the second shredder is also directed into the surge bin. With the aid of a flight-type and a vibrating conveyor the material is next drawn from the surge bin and fed through a rotary feed unit into the air classifier.

Light material (predominantly paper and plastic) is carried upward through the air classifier in the flowing airstream. This light material is separated from the flowing gas stream in a cyclone. The material exits the cyclone, goes through a screw feeder and air lock, and is conveyed pneumatically to the Atlas storage bin.

Heavy material drops out of the bottom of the air classifier onto a conveyor belt and passes over a magnetic tail pulley of the conveyor and onto another conveyor which has a magnetic head pulley. Magnetic material separated at both pulleys goes to the ferrous truck storage unit. The nonmagnetic material passes either down a chute to a reject bin for subsequent

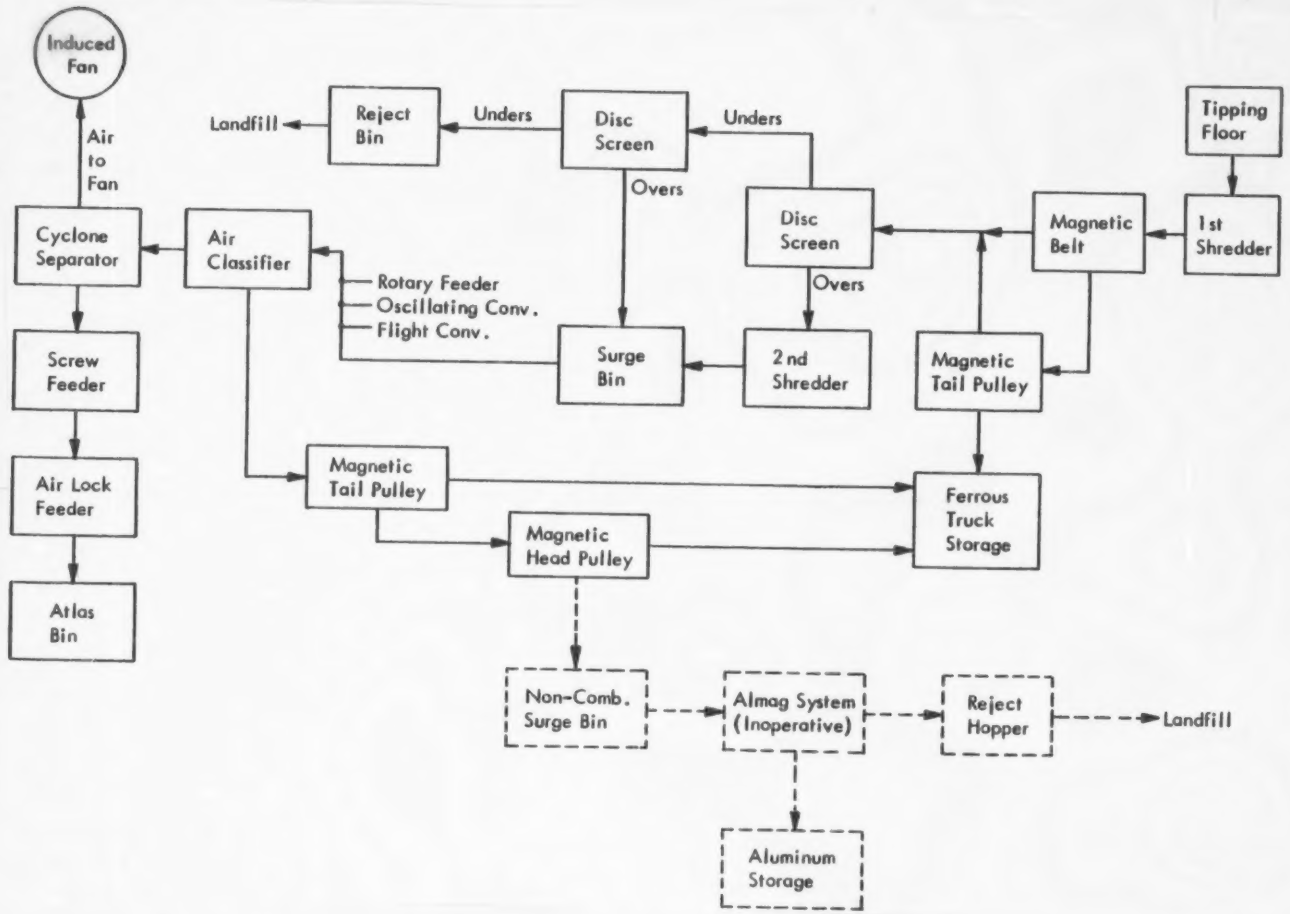
Induced Fan
Air to Fan
Landfill
Reject Bin
Unders
Disc Screen
Unders
Tipping Floor
Overs
Cyclone Separator
Air Classifier
Disc Screen
Magnetic Belt
1st Shredder
Rotary Feeder
Oscillating Conv.
Flight Conv.
Overs
Screw Feeder
Surge Bin
2nd Shredder
Magnetic Tail Pulley
Air Lock Feeder
Magnetic Tail Pulley
Ferrous Truck Storage
Magnetic Head Pulley
Atlas Bin
Non-Comb. Surge Bin
Almag System (Inoperative)
Reject Hopper
Landfill
Aluminum Storage

Figure 37. Flow diagram of solid waste processing plant - Ames, Iowa.

transportation to a landfill or to an aluminum separation system. The aluminum separation system was not operational during the field test covered by this report.

Since the plant is enclosed, the refuse being processed and the fuel fraction of the refuse are protected from the elements. The control room is positioned at a good vantage point for observing plant operation. Selected areas are monitored by closed circuit television.

Air Classifier System

The front half of the Ames air classifier system is shown in Figure 38, and the back half is shown in Figure 39. The system consists of a surge bin, scalping roller, flight conveyor, vibrating conveyor, air lock, air classifier (see Figure 38), cyclone, settling chamber, induced draft fan, twin screw feeder, surge bin, and pneumatic air lock (see Figure 39). Shredded material is drawn from the surge bin by the flight conveyor. The scalping roller levels the burden between the flights to provide uniform conveyor loading. A variable speed drive on the flight conveyor is used to vary the feed rate to the air classifier. The inclined flight conveyor empties onto a vibrating pan conveyor which levels the load going into the rotary air lock. The rotary air lock drops material into the air classifier. A sectional elevation sketch of the air classifier, shown in Figure 40, illustrates the adjustments available to modify the flow profile of the air classifier. The material is fed into an upward moving airstream. Heavy material drops out of the bottom of the air classifier, and the light material is carried upward in the airstream and over to the cyclone (see Figure 39). Solids drop out of the airstream in the cyclone and are transported by a twin screw feeder to a surge bin. A rotary air lock at the bottom of the surge bin meters this light material into a pneumatic tube for transport to a storage silo.

The airflow through the air classifier system is shown in Figure 40. Air pulled in at the bottom of the air classifier passes through the cyclone and is ducted to a settling chamber. Next, air is drawn from the settling chamber by an induced draft fan and pushed through a baghouse to the atmosphere. The settling chamber and baghouse remove particulates from the process air before it is exhausted to the atmosphere. A pneumatically operated iris-type shutter in the intake duct at the fan allows airflow through the air classifier system to be varied at the plant control console. An air bleed gate near the top of the air classifier can also be opened to vary the airflow through the air separation chamber.

Design Performance and Operating Experience

The air classifier system was designed to handle a maximum of 45.4 Mg/h (50 ton/h) of shredded MSW. The refuse is shredded, ferrous metal is separated from the refuse, and part of the refuse is shredded a second time before entering the air classifier.

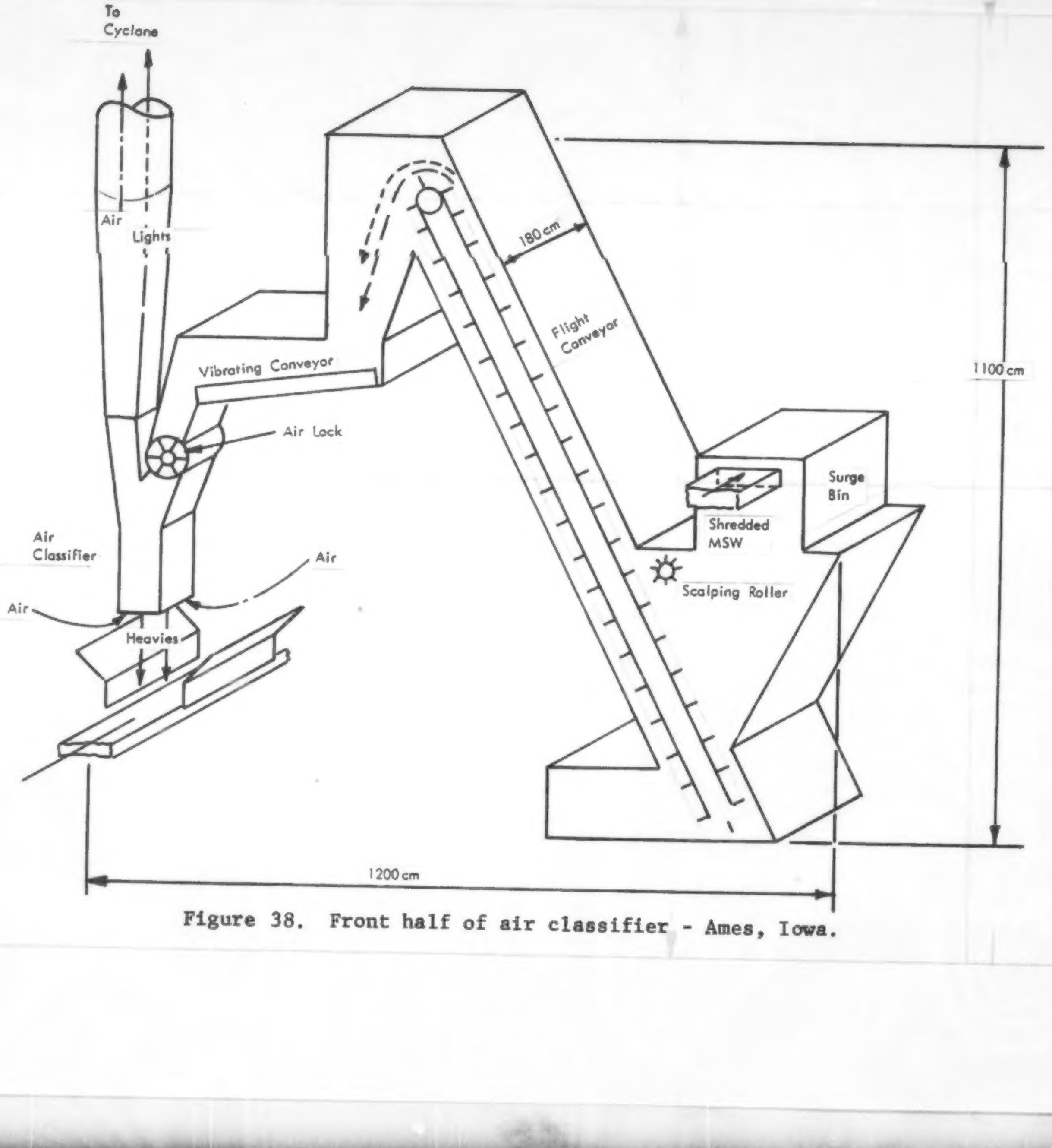
To
Cyclone
Air
Lights
Vibrating Conveyor
180 cm
Flight
Conveyor
1100 cm
Air Lock
Surge
Bin
Shredded
MSW
Scalping Roller
Air
Classifier
Air
Air
Heavies
1200 cm

Figure 38. Front half of air classifier - Ames, Iowa.

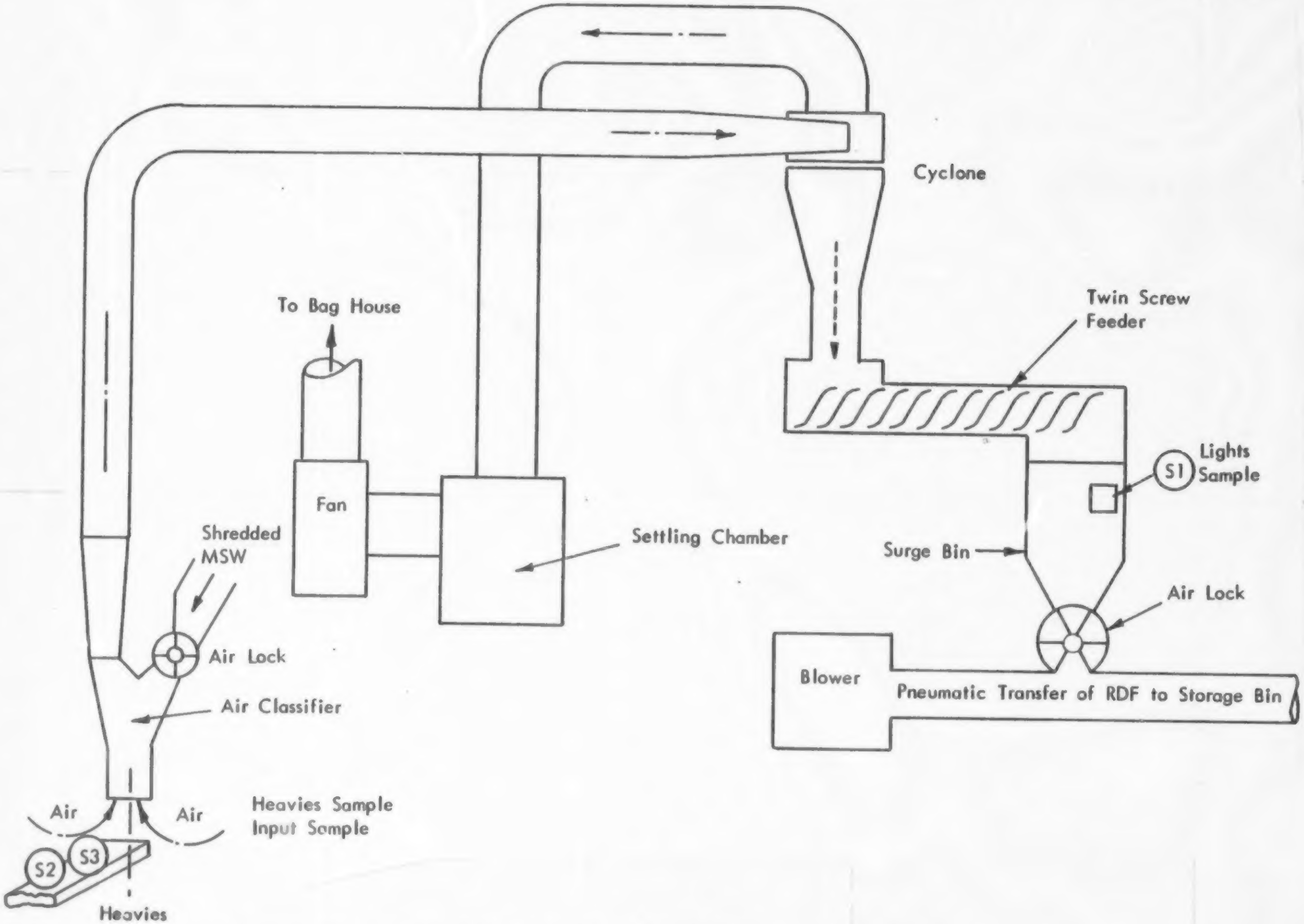
Cyclone
Twin Screw Feeder
To Bag House
Fan
Settling Chamber
Lights Sample
S1
Surge Bin
Air Lock
Blower
Pneumatic Transfer of RDF to Storage Bin
Shredded MSW
Air Lock
Air Classifier
Air
Air
Heavies Sample
Input Sample
S2
S3
Heavies

Figure 39. Back half of air classifier - Ames, Iowa.

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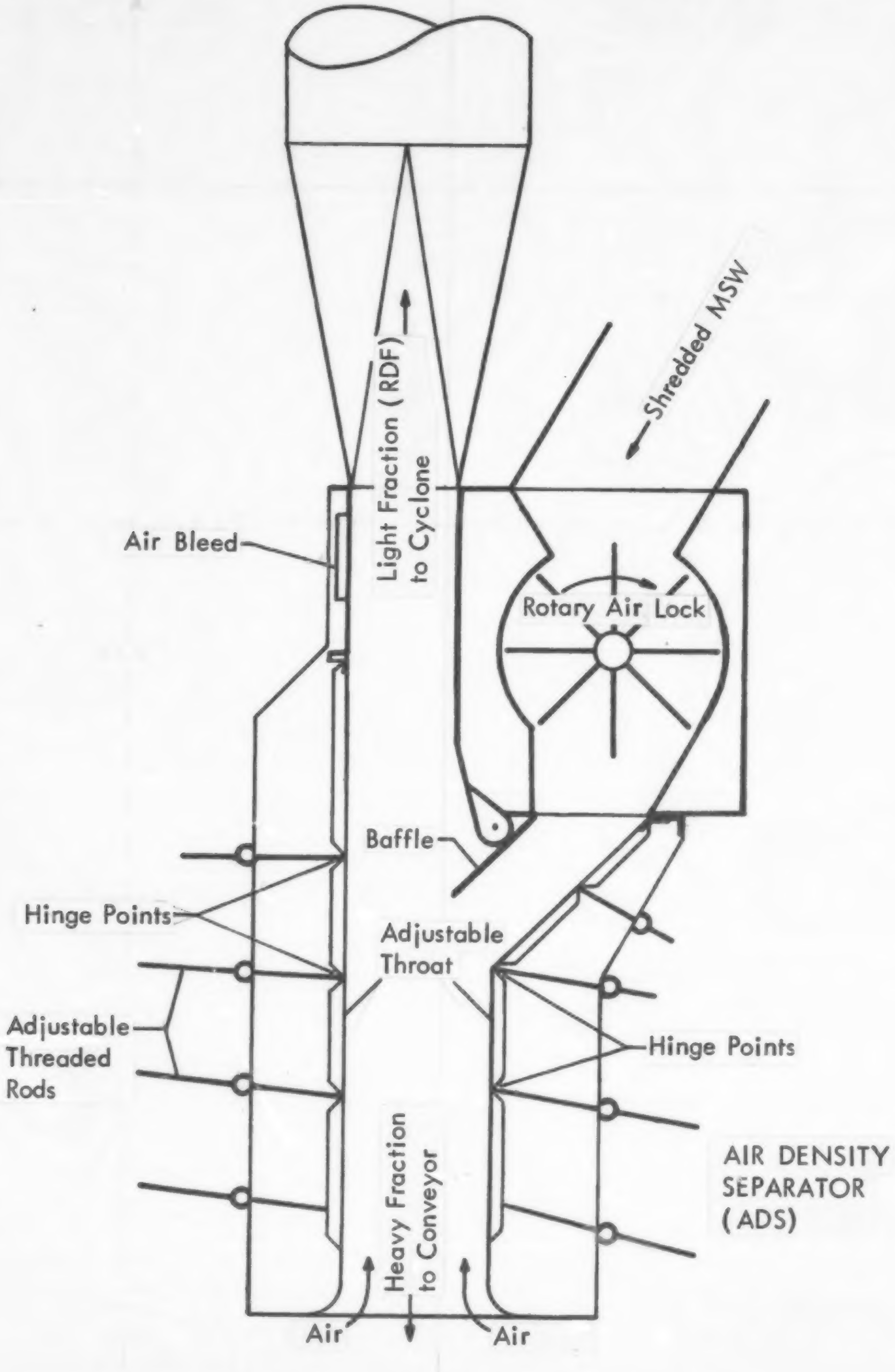
Shredded MSW
Light Fraction (RDF) to Cyclone
Air Bleed
Rotary Air Lock
Baffle
Hinge Points
Adjustable Throat
Adjustable Threaded Rods
Hinge Points
AIR DENSITY SEPARATOR (ADS)
Heavy Fraction to Conveyor
Air
Air

Figure 40. Air separation chamber - Ames, Iowa.

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TYPING GUIDE SHEET

The air classifier system requires five electrical prime movers: an 11-kW (15-hp) unit for the flight conveyor, a 15-kW (20-hp) unit for the vibrating conveyor, an 11-kW (15-hp) unit for the air lock feeder, a 149-kW (200-hp) unit for the fan, and a 19-kW (25-hp) unit for the outlet air lock.

Operating downtime was recorded in 1977.[8] Most of the air classifier system downtime, summarized in Table 6, was attributed to the vibrating screen, the rotary air lock feeder, the reverse flow trap metal screen filter, and heavy fraction conveyor. Of these, the metal screen filter was by far the largest contributor. Excessive wear in the casing of the rotary air lock feeder caused the problem with the filter. This wear permitted air leakage from the pneumatic line to back up through the screw feeder and into the cyclone separator. The backup upset the vortex separation of RDF from the airstream and resulted in material flowing back with the air to the air classifier fan through the reverse air trap filter. This accumulation of material on the filter caused plugging and subsequently downtime in order to clean the filter. Most of the remaining downtime was due to equipment fatigue and wear. Wear is often encountered when dirty and abrasive materials are handled in a dusty environment over a significant period of time.

TABLE 6. AIR CLASSIFIER DOWNTIME, 1977 -
AMES, IOWA

Component	Number of hours
Flight conveyor	2.71
Scalping roll	4.17
Channel	1.43
Vibrating screen	13.24
Rotary air lock feeder	13.75
Cyclone	9.26
Screw feeder	0.75
Reverse flow trap metal screen filter	53.49
Heavy fraction conveyor	18.47
Miscellaneous	15.30

The air classifier system performed significantly better during 1977 than it did in 1976. Better performance was attributed to the operators' improved understanding of system characteristics. Operating data were not obtained for 1978 or 1979, but the data are expected to be similar to the 1977 data. Operators also became more skilled at adjusting the airflow rate through the air classifier to better accommodate changing conditions of infeed material during system operation. This improvement in operation suggests that running a series of tests designed to characterize an RDF plant would be of significant benefit.

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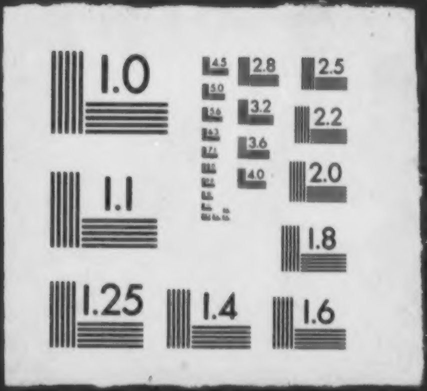
1.0
4.5
5.0
5.6
6.3
7.1
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

Economic Data

The Ames refuse processing plant commenced operations on August 30, 1975. The 1975 air separator system cost was $182,854 which was 17% of the initial capital investment for plant equipment. This amount does not include preparing the site, erecting the shelter, or installing the electrical transmission lines to the equipment. Capital cost on the basis of designed processing capacity was $4,028/Mg/h ($3,657/ton/h) of installed capacity. Air classifier processing costs during 1977 were $0.58/Mg of refuse, which included maintenance and electrical power used by the air classifier system. These air classifier costs are 3% of the total processing costs for the overall plant.

Results of Performance Tests

The usual procedure of sampling the lights and heavies streams could not be followed for this test because of poor accessibility to the lights stream. Therefore, the infeed and heavies streams were sampled and the data for lights were calculated from infeed and heavies sample data. Before taking samples, indicator materials were put in the infeed stream to determine the time for material from the surge bin to pass through the air classifier to the heavies sampling point. The input stream was sampled by inserting a wooden box into the surge bin and withdrawing it after a selected time interval. Since the box was smaller than the cross-sectional area of the surge bin, some material bypassed the box. Bypassed material was estimated to be less than 10% of the total infeed.

The heavies sample was taken off the end of the conveyor belt, which was located directly below the air classifier. This sample was timed to be as near as practical to the zone of material flow for the infeed sample. Sample times were adjusted for each flow rate used so that the sample box in the surge bin would not be filled to overflowing and in order to obtain an acceptable heavies sample weight. Before taking a sample, the conveyor belt leading from the second shredder to the surge bin was observed for uniformity and the infeed rate to the surge bin was estimated to be in the range of interest. It was also observed that under steady operating conditions the flow of shredded material from the surge bin was essentially equal to the flow of shredded material into the surge bin.

A disadvantage due to the necessity of sampling the infeed and heavies streams instead of the heavies and the lights streams was that concurrent samples could not be taken. Because of wide variability in the makeup of MSW over a short time interval, inconsistencies in data can be expected. For example, quantities of a constituent in the heavies stream can exceed the same constituent in the infeed. Such inconsistencies confound data analysis and may preclude using some of the data for air classifier evaluation.

Airflow rate determinations were made using pitot tubes at three locations. One location was in the air classifier body below where the rotary air lock feeds shredded MSW into the air classifier. The other two locations were in ducts on the inlet side of the fan. One point was above the air classifier-to-duct transition zone and the other was ahead of the fan flow control device. A variable air "bleed" into the system located at the top section of the air classifier was opened to different positions during each of the flow rates used during the tests. When bleed occurs the airflow through the zone where heavies and lights separate is less than the airflow through the duct between air classifier body and the fan. The airflow rate used in evaluating this air classifier was that determined by pitot tube measurements made in the air classifier body below the MSW infeed point.

The material flow rate was systematically changed to provide a set of data points which would show the effect of input flow rate on air classifier separation at each of three airflow rates. The amount of material on the conveyor leading to the surge bin was observed by a member of the project field test crew. When the burden on the conveyor was appropriate, the observer started taking the infeed sample. A message was then sent to the heavies sample point to start taking a sample 30 seconds later. Material was taken for a measured length of time at each sampling point, placed in plastic bags, and weighed. From the weight of the samples and sampling time at each sampling point the flow rates were calculated for the infeed and heavy fractions. The lights flow rate was calculated by subtracting the heavies flow rate from the infeed flow rate. The weight of material in the light fraction was plotted as a function of the input feed rate and used as a guide in determining the appropriate feed rate for the next test run. This procedure was repeated until runs at all airflow and input feed rates of interest were completed. Samples were taken at each set of airflow rates and input feed conditions.

The prime movers in the system which consumed energy were the main blower motor, a dust collector blower, two air classifier feed conveyor motors, a dust receiver blower, two dust collector rotary valves, the RDF screw feeder, and the motor for the pneumatic tube air lock.

Data obtained during the performance test are included in Tables E-1 to E-9 in Appendix E.

Concentration factors for paper plus plastic and metal at each MSW input flow rate and each airflow are shown in Table 7. This table clearly shows that the air classifier concentrated paper and plastic as well as aluminum and ferrous materials. For paper and plastic, concentration factors ranged from a low of 1.02 to a high of 1.84. The lowest concentration factor was obtained at the middle airflow rate setting whereas the highest was obtained at the highest airflow rate setting. The lowest average concentration factor was obtained at the lowest airflow rate setting and the highest at the highest airflow rate setting. There did not appear to be a trend of concentration factor versus input feed rate at any of the three airflow rates tested.

Concentration factors obtained for aluminum and ferrous materials were much higher than the factors obtained for paper and plastic. The concentration factors for the aluminum and ferrous materials ranged from 4.35 to 52.98. The lowest factor was obtained at the highest airflow rate setting

TABLE 7. CONCENTRATION FACTORS FOR A MODIFIED VERTICAL RECTANGULAR AIR CLASSIFIER - AMES, IOWA

Lowest airflow rate setting[a]		Middle airflow rate setting		Highest airflow rate setting	
Infeed rate Mg/h	Concentration factor	Infeed rate Mg/h	Concentration factor	Infeed rate Mg/h	Concentration factor
		Paper and Plastic			
2.67	1.10	3.23	1.49	2.09	1.16
7.00	1.05	3.69	1.24	3.21	1.84
12.67	1.11	13.93	1.02	9.00	1.17
15.94	1.07	20.43	1.38	18.05	1.09
19.85	1.31			21.00	1.17
31.75	1.08				
Average	1.12	Average	1.28	Average	1.29
		Ferrous and Aluminum Materials			
2.67	10.41	3.23	7.55	2.09	4.35
7.00	52.98	3.69	43.54	3.21	11.92
12.67	51.79	13.93	29.91	9.00	11.16
15.94	38.42	20.43	5.42	18.05	12.16
19.85	18.04			21.00	24.24
31.75	8.99				
Average	30.11	Average	21.61	Average	12.77

[a] The highest airflow rate through the air classifier was at the lowest airflow setting (11.13 m^3/s), the middle airflow rate was at the highest airflow setting (11.07 m^3/s), and the lowest airflow rate was at the middle airflow setting (10.30 m^3/s). The difference between airflow setting at the fan controls and the measured airflow in the separation zone in the air classifier was due to the air bleed shown in Figure 40.

whereas the highest factor was obtained at the lowest airflow rate. Average concentration factors decreased with increase in the airflow rate setting. There was no clear trend of concentration factor variation with infeed rate.

The ability of the air classifier system to handle refuse for each airflow rate is shown in Figure 41. A plot of the light fraction production versus the infeed rate to the air classifier is given in this figure. The data for each airflow rate showed a uniform increase in the production of lights with infeed rate. This straight line indicates that the split of infeed to lights and heavies is essentially constant; i.e., lights divided by infeed is constant and heavies divided by infeed is constant. A transition zone or choke point where increased infeed causes a substantial change in the output of the light fraction was not encountered as experienced when testing other air classifiers. However, the maximum feed rate of 31.75 Mg/h was only 70% of the designed infeed rate of 45.4 Mg/h. The limitation of other components in the plant precluded testing at higher infeed rates. It is expected that a transition zone would have been reached if test runs had been made at or above the designed infeed rate. The slope of the lines drawn through the data were nearly the same for each airflow setting. It could also be noted that the highest infeed rate test point was at the lowest airflow setting. This may have been possible because the highest airflow rate through the air classifier was realized at the lowest airflow rate setting. The lowest airflow rate through the air classifier was at the middle airflow setting. This lack of agreement between airflow through the air classifier and airflow setting was possible because of the air bleed opening. The air bleed was above the separation zone in the air classifier. Superficial column velocity in the air classifier separation zone was 660.39, 611.34, and 656.76 m/min at the low, middle, and high airflow settings, respectively.

These light fraction production rate curves are expected to be of significant value to the MSW facility operators. The air classifier can handle greater infeed rates than those tested, providing the support equipment and other components in the plant do not impose a limit on the infeed rate. In selecting an infeed rate, the operator needs to balance operating problems and other factors against the projected lights production rate.

Electrical power requirements were measured for the main blower, infeed rotary air lock, vibratory feeder, flight conveyor, screw feeder, rotary air lock to pneumatic conveyor, dust collection receiver fan, rotary air lock, and exhaust fan (see Table E-9 of Appendix E). As expected, the total power requirements increased with airflow delivered by the main fan; however, the maximum airflow rate through the air classifier was realized at lowest air setting and the least at the middle air setting. This difference between air delivered by the main fan and that flowing through the air classifier was caused by the setting of the air bleed located in the air classifier above the separation zone for the lights and heavies. Power requirements were 145.55 kW at the lowest, 154.95 kW at the middle, and 158.45 kW at the highest fan flow settings. Specific energy consumption values are tabulated in Table 8.

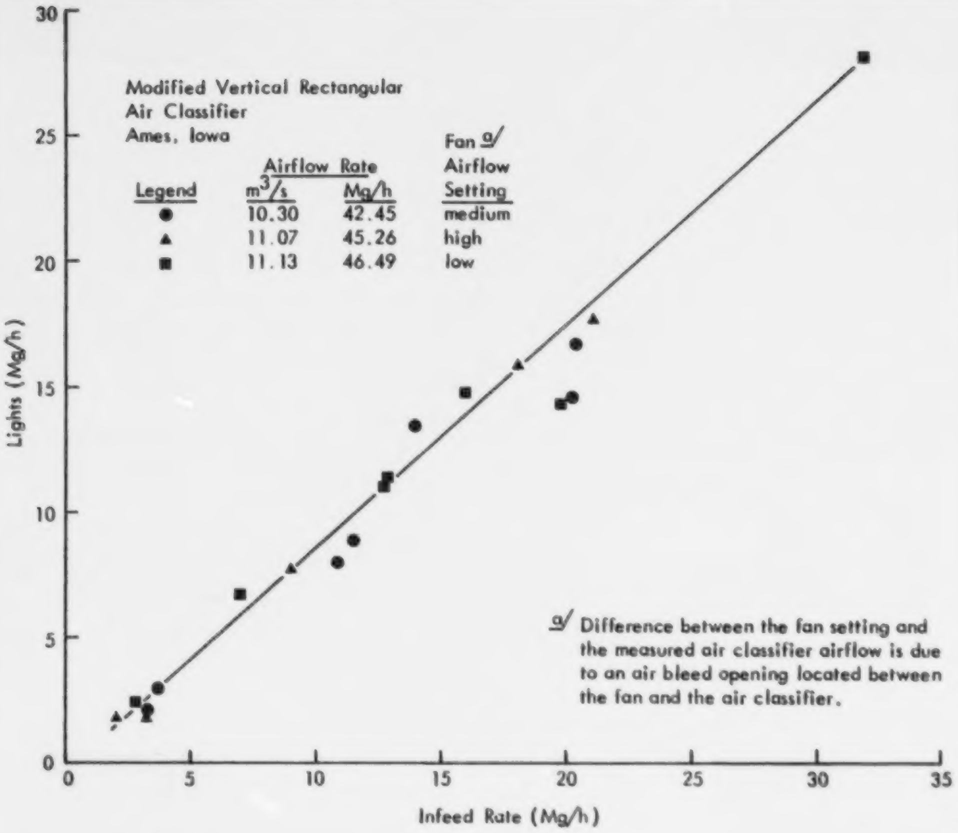

Figure 41. Lights production rate as a function of infeed rate - Ames, Iowa.

TABLE 8. SPECIFIC ENERGY CONSUMPTION - AMES, IOWA

Airflow rate[a] Mg/h	Total kWh used in one hour	Maximum infeed rate Mg/h	Specific energy consumption kWh/Mg
13.32	158.45	21.06	7.52
12.70	154.95	20.50	7.56
11.74	145.55	31.84	4.57

[a] Inlet flow to main fan.

The specific energy consumption varied from 4.57 to 7.56 kWh/Mg. This wide variation could be attributed to the quantity of infeed plus the air bleed setting. For example, the highest infeed rate was used at the lowest air flow setting, 11.74 Mg/h. This was possible because the air bleed was less than that used at the other two airflow settings.

Corrected ash content for the infeed and heavy fractions are given in Table E-1 in Appendix E. Ash content of the lights fraction was determined by subtracting the ash content of the heavies from the ash content of the infeed after normalizing to the appropriate sample size. Consequently, ash content variation will be larger than if the ashed samples were taken directly from the lights stream. Additional variation could be expected because the heavies samples were not taken from the same input that produced the input samples. The percentage of ash content calculated for the lights was generally low, and some negative values were obtained. The negative values indicate that sampling the infeed and heavies streams are inappropriate for determining percentage of ash in the lights. Similar problems can be expected when determining the composition of the lights stream.

Ash content in the heavy fraction was much larger than in the light fraction (see Table E-1 in Appendix E). Ash content ranged from 28.8 to 69.4%, with an average of 49.7%.

Table 9 shows LFC for various refuse infeed rates at each airflow rate. The ash content of several samples was less than the 11% of ash normally expected. Whenever the ash content was 11% or less, the LFC was considered to be 100%. The Ames plant used two sets of disc screens ahead of the air classifier, which permitted much of the grit, glass, and small metal particles to drop out of the infeed stream. The level of the LFC is a clear indication that the disc screens raise the value of RDF produced by the plant. The range and average LFC values at each airflow rate were similar. Average LFC values at airflow rates of 11.07 and 11.13 m^3/s were slightly lower than at 10.30 m^3/s.

TABLE 9. LIGHT FRACTION COMBUSTIBLES FOR A MODIFIED VERTICAL RECTANGULAR AIR CLASSIFIER - AMES, IOWA

Feed rate (Mg/h)	LFC (%) airflow 10.30 m^3/s	Feed rate (Mg/h)	LFC (%) airflow 11.07 m^3/s	Feed rate (Mg/h)	LFC (%) airflow 11.13 m^3/s
3.23	100.0	2.09	97.3	2.67	100.0
3.69	100.0	3.21	100.0	7.00	100.0
13.93	95.2	9.00	100.0	12.77	100.0
20.27	100.0	18.05	93.5	15.94	100.0
20.43	100.0	21.00	100.0	19.85	100.0
				31.75	92.82
Average	99.04	Average	98.16	Average	98.82

Table 10 shows RDF yield over a range of infeed rates for each of the three airflow rates. There was no trend of the RDF yield to increase or decrease with either infeed rate or airflow rate. RDF yield was generally high. The high values and lack of a trend may be the result of taking samples from different input stream segments.

TABLE 10. REFUSE-DERIVED FUEL YIELD FOR A MODIFIED VERTICAL RECTANGULAR AIR CLASSIFIER - AMES, IOWA

Feed rate (Mg/h)	RDF-Y (%) airflow 10.30 m^3/s	Feed rate (Mg/h)	RDF-Y (%) airflow 11.07 m^3/s	Feed rate (Mg/h)	RDF-Y (%) airflow 11.13 m^3/s
3.23	64.91	2.09	82.87	2.67	89.51
3.69	80.16	3.21	52.94	7.00	94.81
13.93	91.97	9.00	85.00	12.77	88.80
20.27	71.47	18.05	81.81	15.94	93.29
20.43	81.76	21.00	84.21	19.85	71.91
				31.75	82.10
Average	78.05	Average	77.37	Average	86.74

A plot of the percentage of paper and plastic in heavies versus infeed rate to airflow rate weight ratio is given in Figure 42. The percentage of paper and plastic in the heavies was generally low but tended to increase when increasing the infeed rate to airflow rate ratio. It can be surmised from this plot that no single airflow rate was clearly preferred.

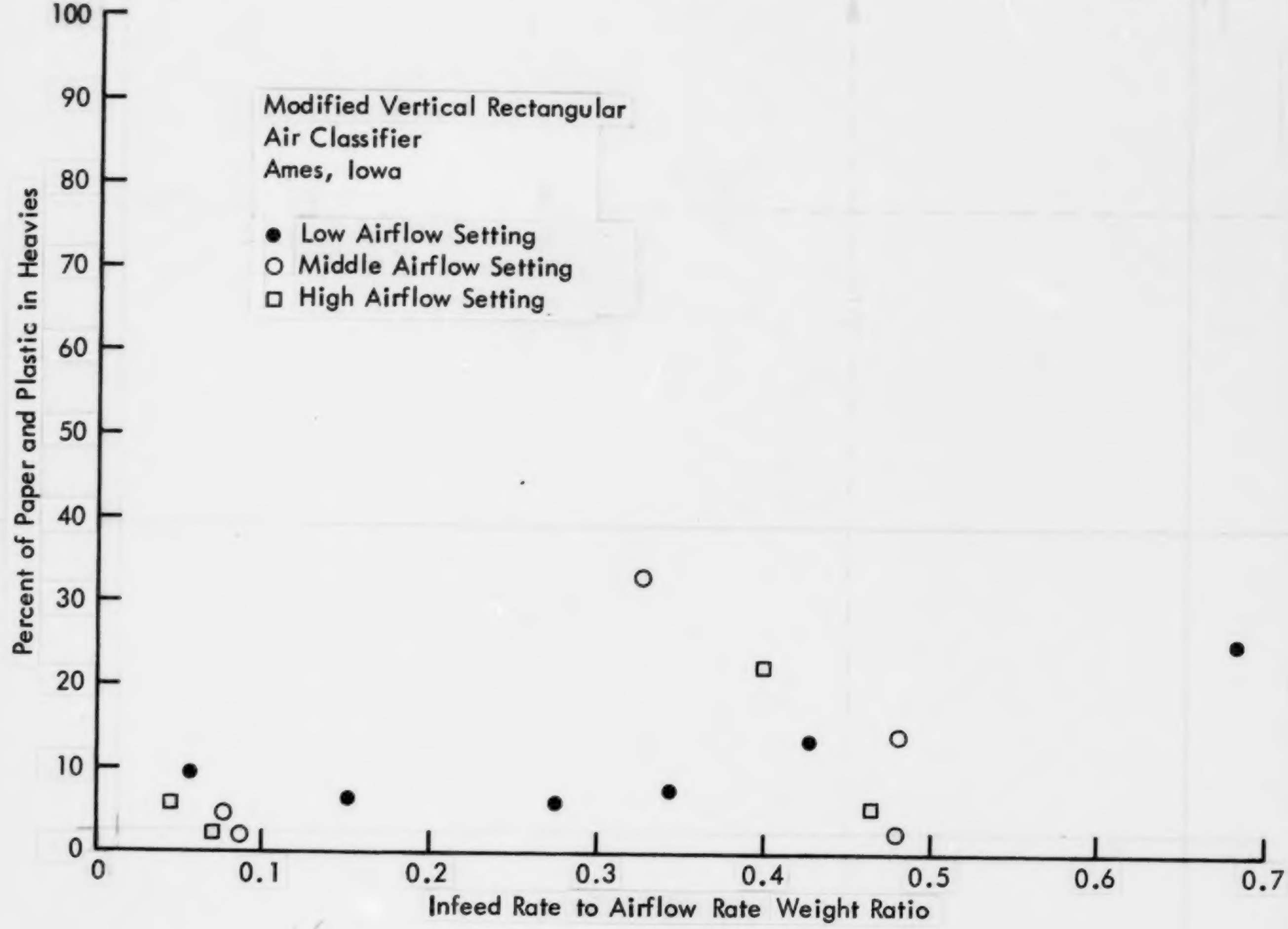

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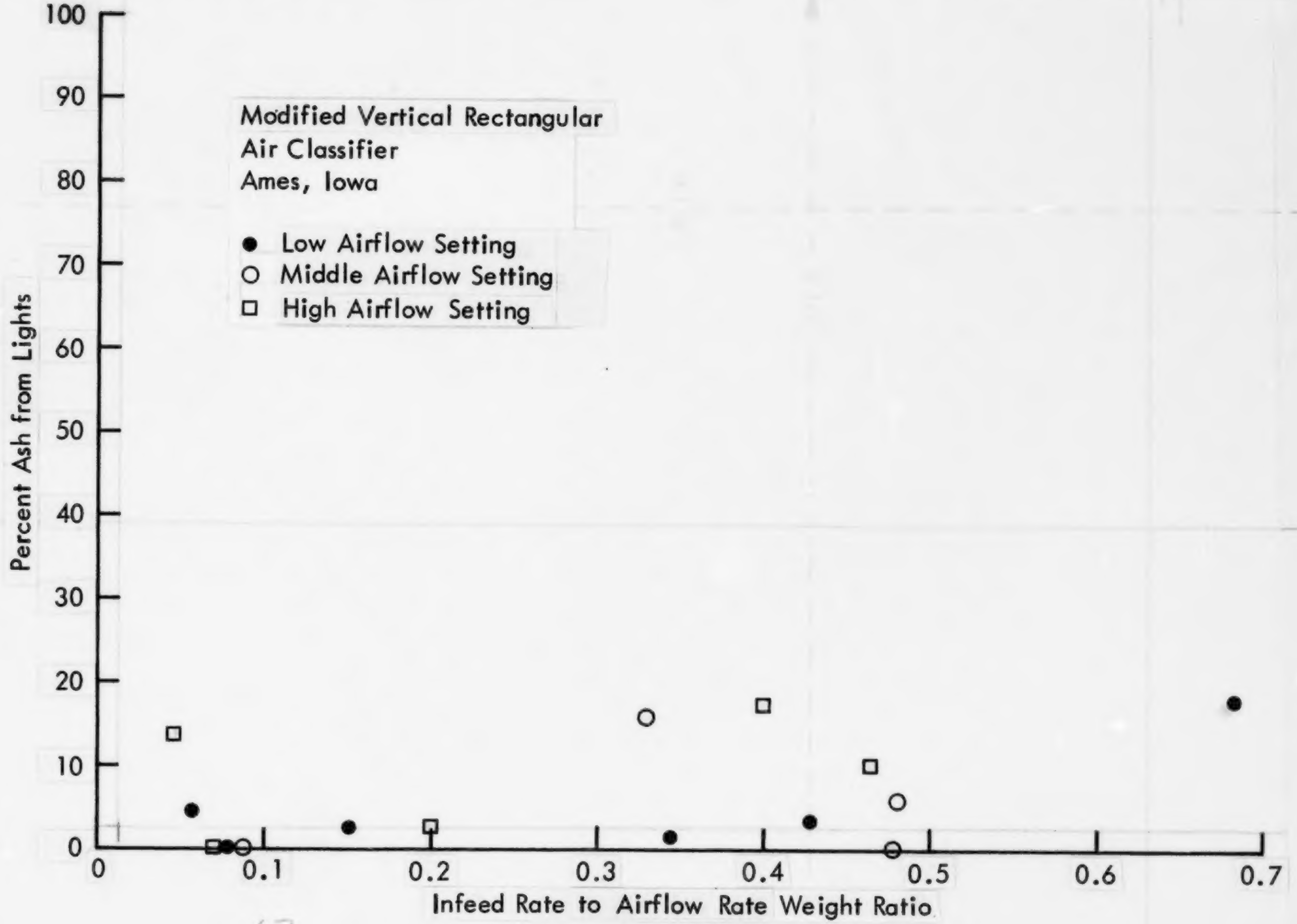
Figure 42. Percentage of paper and plastic in lights versus solids to air weight ratio - Ames, Iowa.

A plot of the percentage of ash from lights versus infeed rate to airflow rate weight ratio is given in Figure 43. Ash from burning paper and plastic was generally in the range of 10 to 12% weight. Since the plot shows that ash was usually less than 10 to 12% weight, it may be concluded that little grit, glass, or metal was carried over with the lights. However, the sampling method has introduced considerable uncertainty as to the sufficiency of the data. The uncertainty also confounds identifying the preferred airflow rate and any trend in the percentage of ash from lights with increasing infeed rate to airflow rate weight ratio.

A plot of the percentage of lights produced versus infeed rate to airflow rate weight ratio is shown in Figure 44. Data scatter was considerable, but the production of lights appeared to be flat with a slight downtrend with increase of infeed rate to airflow rate ratio. The greatest production of lights could be noted at the highest airflows through the air classifier separation zone, i.e., the low and high airflow rate settings.

The average oven dry heating value for the eight samples analyzed for heating value was 19,532 kJ/kg for the lights and 10,172 kJ/kg for the heavies, a 47.9% difference. Therefore light fraction energy recovery was higher than light fraction material weight recovery. Percentage of total energy contained in the infeed recovered by the air classifier in the light fraction varied between 95.7% and 81.4% and is plotted in Figure 45. The trend is that the higher percentage energy recoveries occur at the lower infeed rates and at the higher airflow rates.



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solids

Figure 43. Percentage of ash from lights versus solids to air weight ratio - Ames, Iowa.

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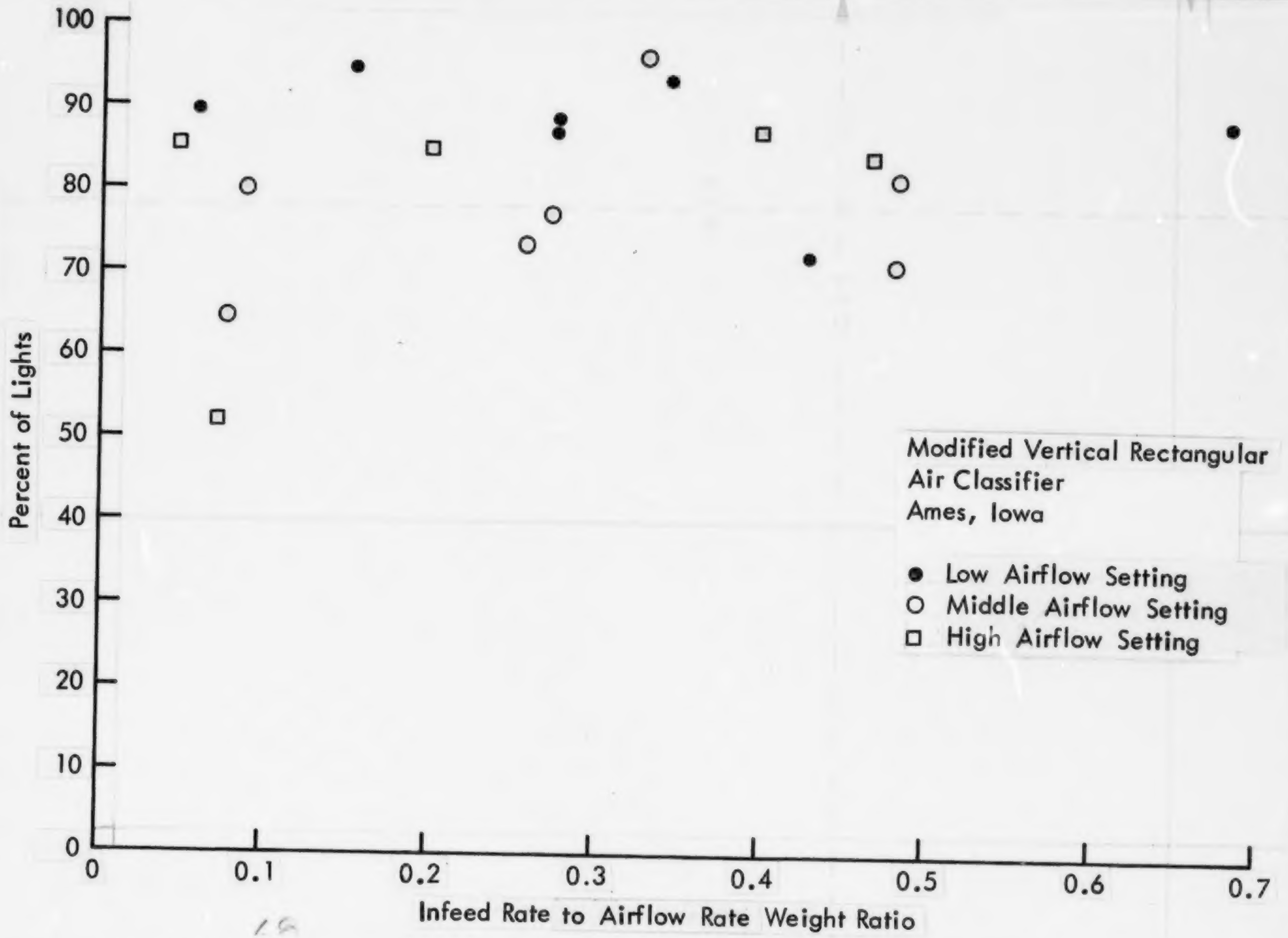

Figure 44. Percentage of lights versus solids to air weight ratio - Ames, Iowa.

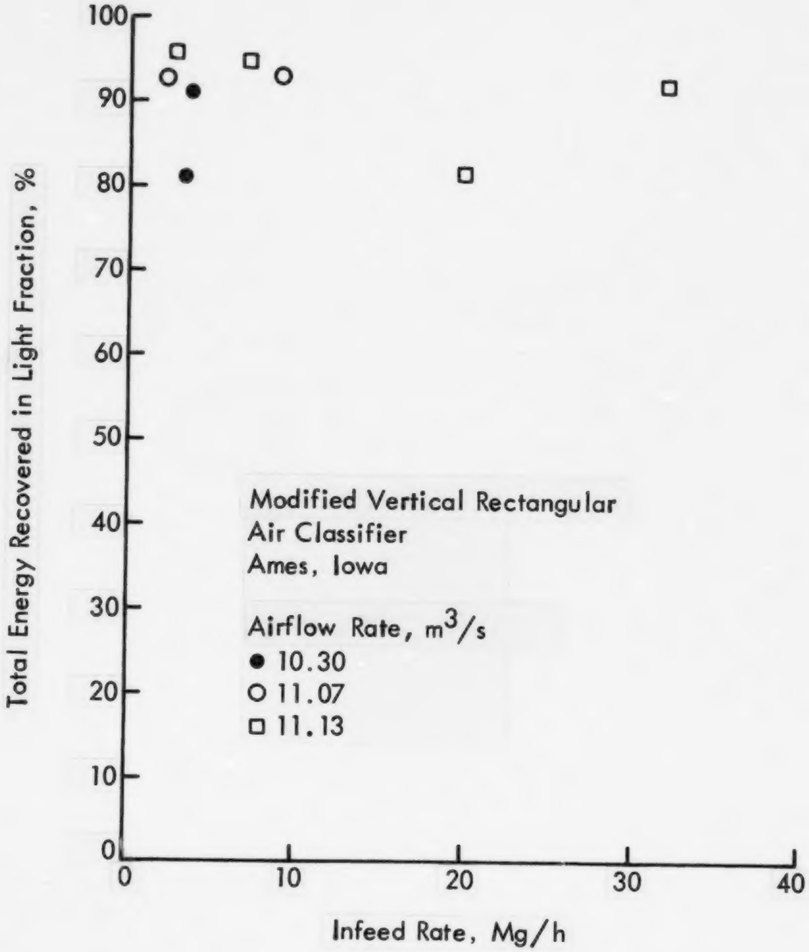

Figure 45. Energy recovery versus infeed rate - Ames, Iowa.

DUAL VORTEX AIR CLASSIFIER--LOS ANGELES, CALIFORNIA

General Description of Refuse Plant

A block diagram of the experimental refuse processing plant is shown in Figure 46. In operation, material is pushed out the back of a packer truck into the tipping pit. A flight conveyor lifts material from the pit and drops it into a Heil shredder. Shredded material exits at the bottom of the shredder onto an inclined, troughed belt conveyor. This conveyor delivers the shredded MSW to the rotary air lock of the air classifier. The rotary air lock drops the shredded MSW into the air classifier. The flowing airstream, which enters the bottom of the air classifier, carries the lights upward to a cyclone where the lights drop out through a rotary air lock onto a conveyor. The conveyor carries the RDF to a packer truck. The heavies drop out of the bottom of the air classifier onto a conveyor. The conveyor passes a magnetic separator unit which separates ferrous material from the heavies stream. The ferrous material is collected from subsequent transport to a scrap dealer. The other part of the heavies stream is collected for transport to a landfill.

Air Classifier System

The air classifier system consists of a dual vortex air classifier, a cyclone, and an induced draft fan (see Figure 46). A sketch of the air classifier unit is shown in Figure 47. Shredded MSW is conveyed to the rotary air lock, which drops shredded MSW into the air classifier. The shape of the air classifier and positioning of a baffle just below the rotary air lock induces a turbulent zone to break up clumps of MSW. A second baffle, located near the bottom of the air classifier, induces a second turbulent zone in the unit. This second zone, more turbulent than the first, is intended to break up the more stubborn clumps of MSW. Breakup of clumped MSW permits light material, predominantly paper and plastic, to be carried upward with the flowing stream of air rather than be dropped out the bottom of the air classifier with the heavy material. The baffles can be set to vary the size and location of the turbulent zones. The position set by the operating crew of the plant was kept constant throughout all test runs.

Airflow is generated by an induced draft fan. Airflow through the air classifier system is varied by adjusting a baffle on the outlet of the fan. Air from the discharge side of the fan is exhausted directly to the atmosphere. Airflows were measured with the aid of an impact pitot tube in two locations. One location was in the air classifier at the light and heavies separation zone. The other was in a straight run of a 0.48-m (19-in.) duct connecting the cyclone to the induced draft fan, about 4 m (13.1 ft) ahead of the blower inlet. Airflow rate data are given in Table F-2 of Appendix F.

Design Performance and Operating Experience

The air classifier system has a rated capacity of 3.64 Mg/h (4 ton/h) when handling shredded MSW of a size 19 cm (7.5 in.) or less. Manufacturer's tests indicate that the unit has a surge capacity of 120% of rated capacity

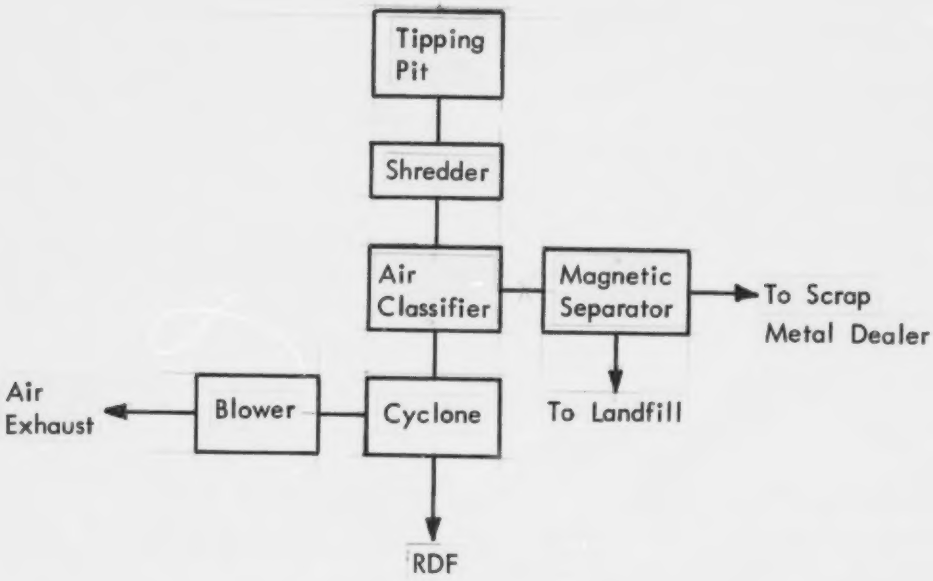
Tipping Pit
Shredder
Air Classifier
Magnetic Separator
To Scrap Metal Dealer
To Landfill
Air Exhaust
Blower
Cyclone
RDF

Figure 46. Flow diagram of experimental refuse processing plant - Los Angeles, California.

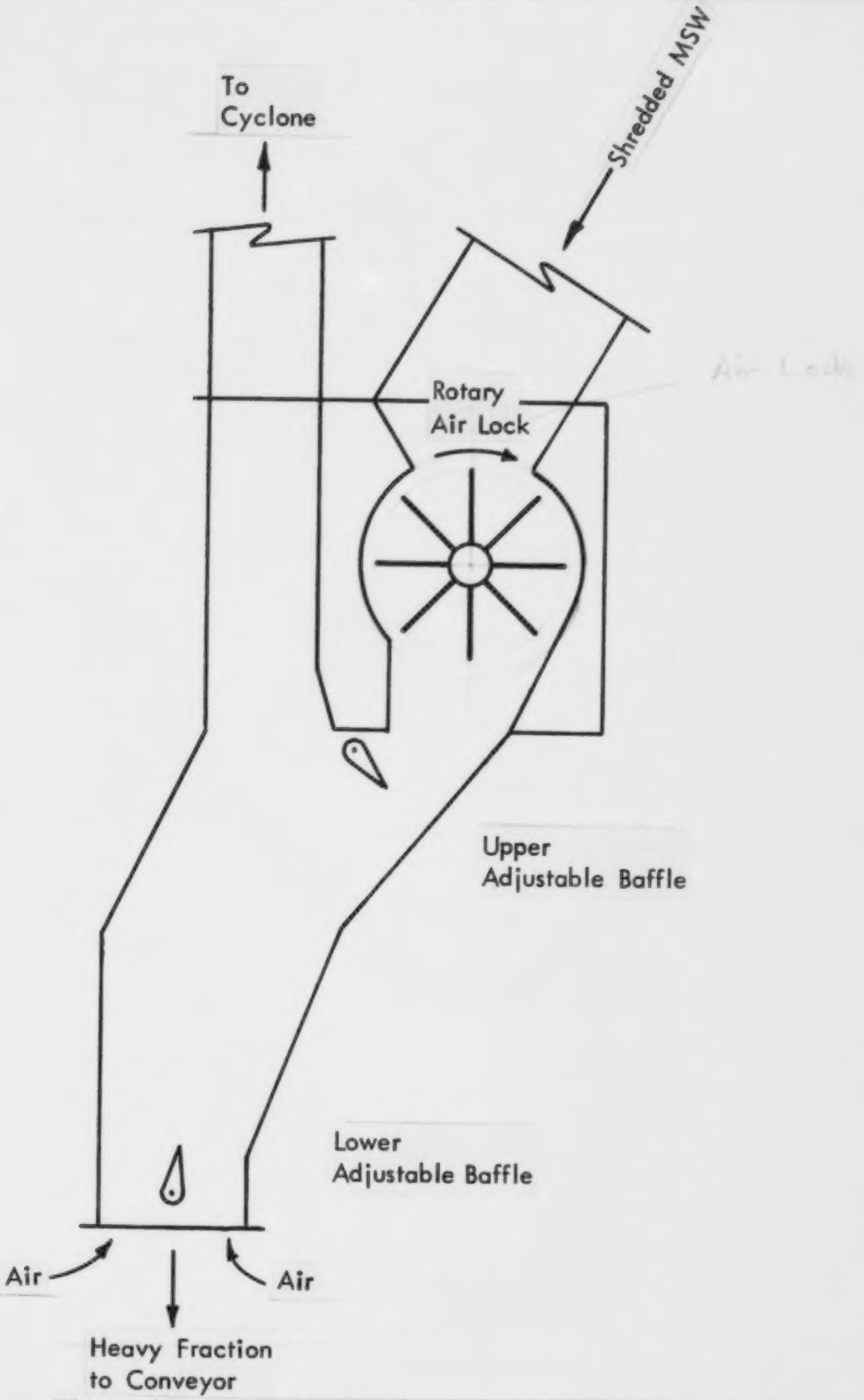
To Cyclone
Shredded MSW
Air Lock
Rotary Air Lock
Upper Adjustable Baffle
Lower Adjustable Baffle
Air
Air
Heavy Fraction to Conveyor

Figure 47. Air classifier - Los Angeles, California.

with no significant decrease in the split to light ratio. MSW is shredded to a nominal 7.6 cm (3 in.) in this experimental processing plant. The air classifier system requires three electric prime movers: a 0.56-kW (0.75-hp) motor to turn the air lock feeder, a 2-kW (3-hp) motor to turn the cyclone air lock, and a 37-kW (50-hp) motor to drive the induced draft blower.

Even though it is an experimental unit, the air classifier system is sufficiently heavy to permit continuous operation. The conveyor to the rotary air lock of the air classifier is covered and acts as a duct for air exhausted by the shredder. A vent and a settling chamber can reduce the amount of solids leaking from the covered conveyor. During the tests the rotary air lock feeder sometimes jammed when large, rigid pieces of refuse, such as wooden blocks or sticks, passed through the shredder without sufficient size reduction.

The vortex-inducing baffle at the lower end of the air classifier seemed to cause jams when slugs of material reported to the heavies. Operators of the plant wondered if it was more a problem than a benefit. One member of the crew was stationed near the lower end of the air classifier to dig out jams and thus prevent collapse of the duct work.

Economic Data

Component and installation costs for the year 1977 estimated for this experimental unit are given in Table 11. The estimate did not include engineering fees and site preparation costs. No data were available for operating and maintenance costs.

TABLE 11. ESTIMATED COSTS FOR DUAL VORTEX AIR CLASSIFIER - LOS ANGELES, CALIFORNIA

Item (installed in 1977)	Cost ($)
Feed air lock, motor, and feed gate	1,500
Column materials and labor	5,000
Cyclone	900
Cyclone air lock and motor	300
Blower	800
Damper	100
Control panel and motor starters	700
Duct work	200
Electrical installation	500
Materal installation	
Crane operator	250
Other	2,000
Total[a]	12,250

[a] Excludes engineering fees and site preparation costs.

The capital cost on the basis of rating processing capacity of 3.6 Mg/h was $3,403/Mg/h ($3,063/ton/h).

Results of Performance Tests

The lights and heavies streams were sampled by collecting material on a plastic sheet spread under the outlet end of the lights and heavies conveyors. The plastic sheets were inserted at selected times and withdrawn with the sample after a specific time interval. A small wooden plank was fed into the shredder to determine the time lag between starting to take the heavies and lights sample. This was done so that samples could be taken from the same segment of infeed stream. Shredded wood is a good indicator material because part of the shredded material reports to the lights and the remainder reports to the heavies. In addition, splintered wood can be readily identified. Sample weights were measured to the nearest 28 g (1 oz) on a small platform scale.

To obtain the desired feed rate, the flight conveyor was stopped intermittently and material from the tipping pit was raked onto it. Once the entire conveyor was loaded, the material was fed into the shredder at a constant rate. The amount of material loaded onto the flight conveyor governed the feed rate of shredded MSW to the air classifier. The conveyor load was varied to cover the range of interest at each of the three airflow rates used in testing this air classifier. Airflow rates of 2.69, 4.01, and 4.99 m^3/s were used. With a 0.378-m^2 cross-sectional area in the separation zone of the air classifier, these airflow rates produced a superficial air velocity of 425.9, 637.6, and 791.0 m/min, respectively.

Data obtained during the performance test are included in Tables F-1 to F-9 in Appendix F.

Concentration factors for paper plus plastic and metal at each MSW input flow rate and each airflow are shown in Table 12. This table clearly shows that the air classifier concentrates paper and plastic as well as aluminum and ferrous materials. For paper and plastic, concentration factors ranged from a low of 1.01 to a high of 1.37. The lowest concentration factor was obtained at the middle airflow rate whereas the highest was obtained at the lowest airflow rate. The lowest average concentration factor was obtained at the middle airflow rate and the highest at the lowest airflow rate. There does not appear to be a trend of concentration factor versus input feed rate at any of the three airflow rates tested.

Concentration factors obtained for aluminum and ferrous materials were generally much higher than the factors obtained for paper and plastic. The concentration factors for the aluminum and ferrous materials ranged from 1.04 to 11.43. The lowest factor was obtained at the lowest airflow rate whereas the highest factor was obtained at the middle airflow rate. The lowest average concentration factor was obtained at the lowest airflow rate and the highest at the middle airflow rate. There does not appear to be a trend of concentration factor versus infeed rate of any of the three airflow rates.

TABLE 12. CONCENTRATION FACTORS FOR DUAL VORTEX AIR CLASSIFIER - LOS ANGELES, CALIFORNIA

Lowest airflow rate		Middle airflow rate		Highest airflow rate	
Infeed rate Mg/h	Concentration factor	Infeed rate Mg/h	Concentration factor	Infeed rate Mg/h	Concentration factor
		Paper and Plastic			
0.32	1.33	0.42	1.25	0.56	1.14
0.79	1.35	0.46	1.05	1.88	1.04
1.70	1.24	1.96	1.21	2.14	1.14
3.47	1.37	5.21	1.01	8.22	1.14
4.59	1.12	5.41	1.16	11.85	1.28
8.45	1.27				
Average	1.28	Average	1.14	Average	1.15
		Ferrous and Aluminum Materials			
0.32	2.14	0.42	4.61	0.56	6.67
0.79	2.60	0.46	10.06	1.88	9.24
1.70	2.83	1.96	4.82	2.14	4.58
3.47	1.81	5.21	11.43	8.22	2.45
4.59	2.00	5.41	2.49	11.85	1.32
8.45	1.04				
Average	2.07	Average	6.68	Average	4.85

The ability of the air classifier system to handle refuse for each airflow rate is shown in Figures 48. A plot of the light fraction production versus the infeed rate to the air classifier is given in these figures. The data for each airflow rate show a uniform increase in the production of lights and with infeed rate. A transition zone where increased infeed caused a substantial change in the output of the light fraction was encountered at the lowest and highest airflow rates but not at the middle airflow rate. It is not understood why a transition zone was not encountered during the middle airflow rate. It is possible that the highest point is an anomaly or that the size and location of induced vortices favor the middle airflow rate. From the standpoint of separating a light fraction from shredded MSW, it can be deduced from Figure 48 that the middle airflow rate was preferred. The percentage of the infeed rate reporting to the lights was essentially the same for the middle and high airflow rates to rated capacity of the air classifier (3.64 Mg/h), but infeed surges above rated capacity are handled better at the middle airflow rate.

Electrical power requirements were measured for the infeed rotary air lock, cyclone rotary air lock and induced draft blower. Measurements were made at the three airflow rates for each prime mover and totaled for the overall air classifier system at each airflow rate (see Table F-9 of Appendix F). No MSW was fed to the system during the time that airflow rate measurements were taken. As expected, the total power requirements increased with airflow delivered by the main fan. However, this increase was relatively small because the airflow rate was controlled by varying the fan outlet baffle. Power requirements were 22.9 kW at the lowest airflow rate, 26.1 kW at the middle airflow rate, and 26.4 kW at the highest airflow rate. Specific energy consumption values are tabulated in Table 13.

There was little change in the specific energy consumption even though the highest airflow rate through the air classifier was over 1.8 times the lowest airflow rate. This fact can be attributed to the type of airflow rate control (blower discharge restriction) used on the air classifier system.

Corrected ash content for the light fraction is given in Table F-1 in Appendix F. The ash content in the light fraction provides an indication of noncombustible carry-over with the lights. The ash content of the light fraction produced with this air classifier ranged from a low of 13.8% to a high of 44.9%. These values clearly indicate that this air classifier carried over a sizable quantity of noncombustibles along with the light fraction. The quantity of material that passed through the smallest sieve (see Table F-6 in Appendix F) and the substantial weight in the aluminum, ferrous materials, and the "other" categories of the sample composition (see Table F-7 in Appendix F) tend to support the statement that substantial quantities of noncombustibles are carried over with the lights. These values are sufficiently high to be of concern to a user of RDF.

Ash content in the heavy fraction was generally much larger than in the light fraction (see Table F-1 in Appendix F). Ash content ranged from 21.3 to 75.2%, with an average of 49.8%.

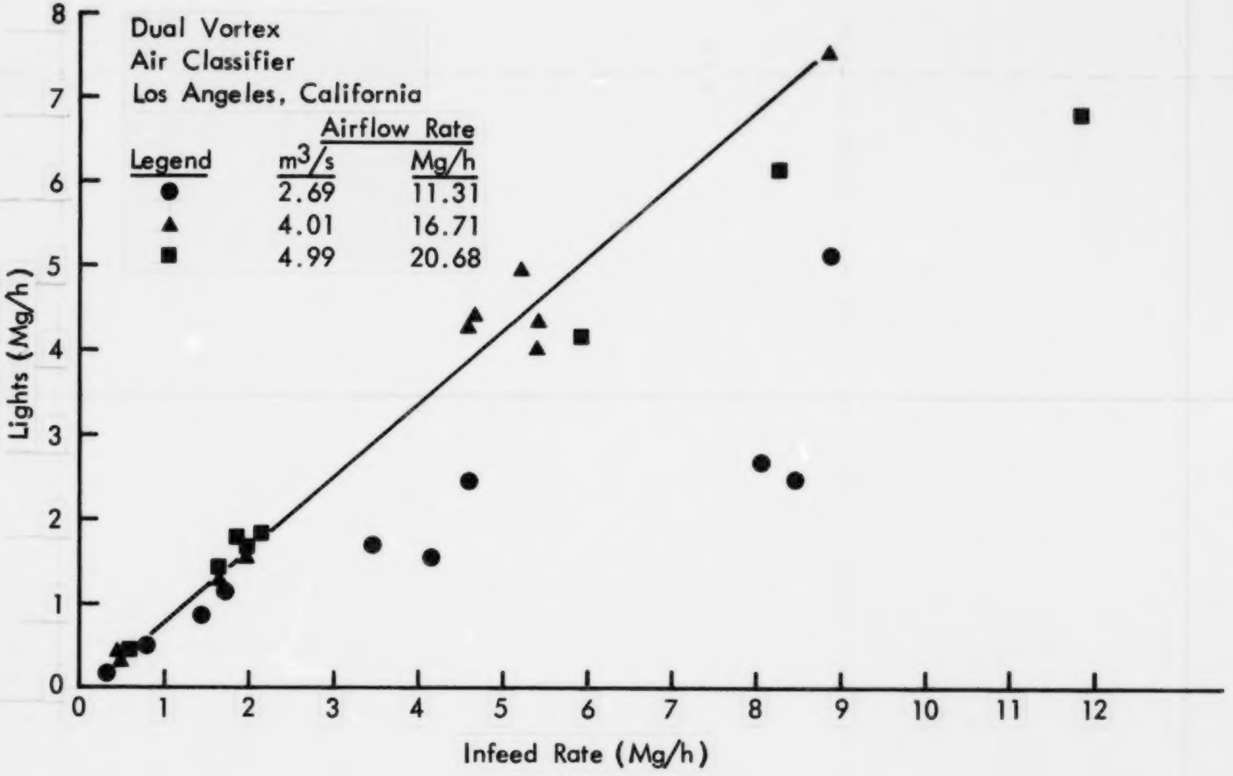

Figure 48. Lights production rate as a function of infeed rate - Los Angeles, California.

TABLE 13. SPECIFIC ENERGY CONSUMPTION - LOS ANGELES, CALIFORNIA

Airflow rate[a] Mg/h	Total kWh used in one hour	Rated or transition point infeed rate Mg/h	Specific energy consumption kWh/Mg
11.31	22.9	2.9[a]	7.90
16.71	26.1	3.36[b]	7.76
20.68	26.4	3.36[b]	7.85

[a] Infeed rate at transition point.
[b] Infeed rate at rated capacity.

Table 14 shows LFC for various refuse infeed rates at each airflow rate. There was no trend for LFC to vary directly or inversely with infeed rate. The highest average LFC value was realized at the middle airflow rate, with the average at the lowest airflow rate running a close second. The average LFC at the highest airflow rate was noticeably lower than at the other two rates.

TABLE 14. LIGHT FRACTION COMBUSTIBLES USING A DUAL VORTEX AIR CLASSIFIER - LOS ANGELES, CALIFORNIA

Feed rate (Mg/h)	LFC (%) at airflow of 2.69 m^3/s	Feed rate (Mg/h)	LFC (%) at airflow of 4.01 m^3/s	Feed rate (Mg/h)	LFC (%) at airflow of 4.99 m^3/s
0.32	86.0	0.42	89.0	0.56	71.1
0.79	84.7	0.46	88.5	1.88	86.0
1.70	92.9	1.96	69.5	2.14	73.1
3.47	82.5	5.21	97.2	8.22	66.3
4.59	87.7	5.41	87.9	11.85	77.0
8.45	66.1				
Average	83.3	Average	86.4	Average	74.7

Table 15 shows RDF yield over a range of infeed rates for each of the three airflow rates. The lowest RDF yield was observed at the lowest airflow rate and highest at the highest infeed rate. At the middle airflow rate the highest RDF yield was observed at the highest infeed rate. The lowest average

RDF yield was at the lowest airflow rate and the highest at the middle airflow rate. The highest average RDF yield was found at the middle airflow rate, and it was significantly higher than the average found for the other two airflow rates.

TABLE 15. REFUSE-DERIVED FUEL YIELD USING A DUAL VORTEX AIR CLASSIFIER - LOS ANGELES, CALIFORNIA

Feed rate (Mg/h)	RDF-Y (%) at airflow of 2.69 m^3/s	Feed rate (Mg/h)	RDF-Y (%) at airflow of 4.01 m^3/s	Feed rate (Mg/h)	RDF-Y (%) at airflow of 4.99 m^3/s
0.32	49.2	0.42	70.4	0.56	61.8
0.79	53.2	0.46	84.0	1.88	82.1
1.70	63.6	1.96	56.2	2.14	62.7
3.47	42.5	5.21	70.0	8.22	49.6
4.59	50.0	5.41	91.9	11.85	44.3
8.45	19.2				
Average	46.3	Average	74.5	Average	60.1

A plot of the percentage of paper and plastic in heavies versus infeed rate to airflow rate weight ratio is given in Figure 49. The percentage of paper and plastic in the heavies tends to increase with increasing infeed rate to airflow rate ratio. The infeed rate to airflow rate ratio at the rated capacity of the air classifier (3.36 Mg/h) and the low, middle, and high airflow rates are 0.322, 0.218, and 0.176, respectively. When operated at rated capacity and below, at either the middle or the high airflow rates, paper and plastic rejected to the heavies was generally less than 10%, whereas at the low airflow rate values ranged from 1.44 to 22.38%. On the basis of paper and plastic rejection to the heavies at infeed rates to rated capacity of the air classifier, either one of the higher airflow rates is preferred.

A plot of the percentage of ash from lights versus infeed rate to airflow rate weight ratio is given in Figure 50. Ash from burning paper and plastic ranged from 13.8 to 44.9% weight. The level of ash content at all airflow rates showed considerable noncombustibles were carried over with the lights at each infeed rate. The level of ash strongly suggests the need for another processing step to remove noncombustibles (glass, grit, and metals). The lowest airflow rate can be expected to carry over the least amount of noncombustibles with the lights, whereas the high airflow rate is expected to carry over the most amount of noncombustibles.

A plot of the percentage of lights produced versus infeed rate to airflow rate weight ratio is shown in Figure 51. It can be seen that the lowest production of lights to the rated capacity of the air classifier occurs at the lowest airflow rate. Lights production at the other two airflow rates are comparable and much higher than that produced at the lowest airflow rate.

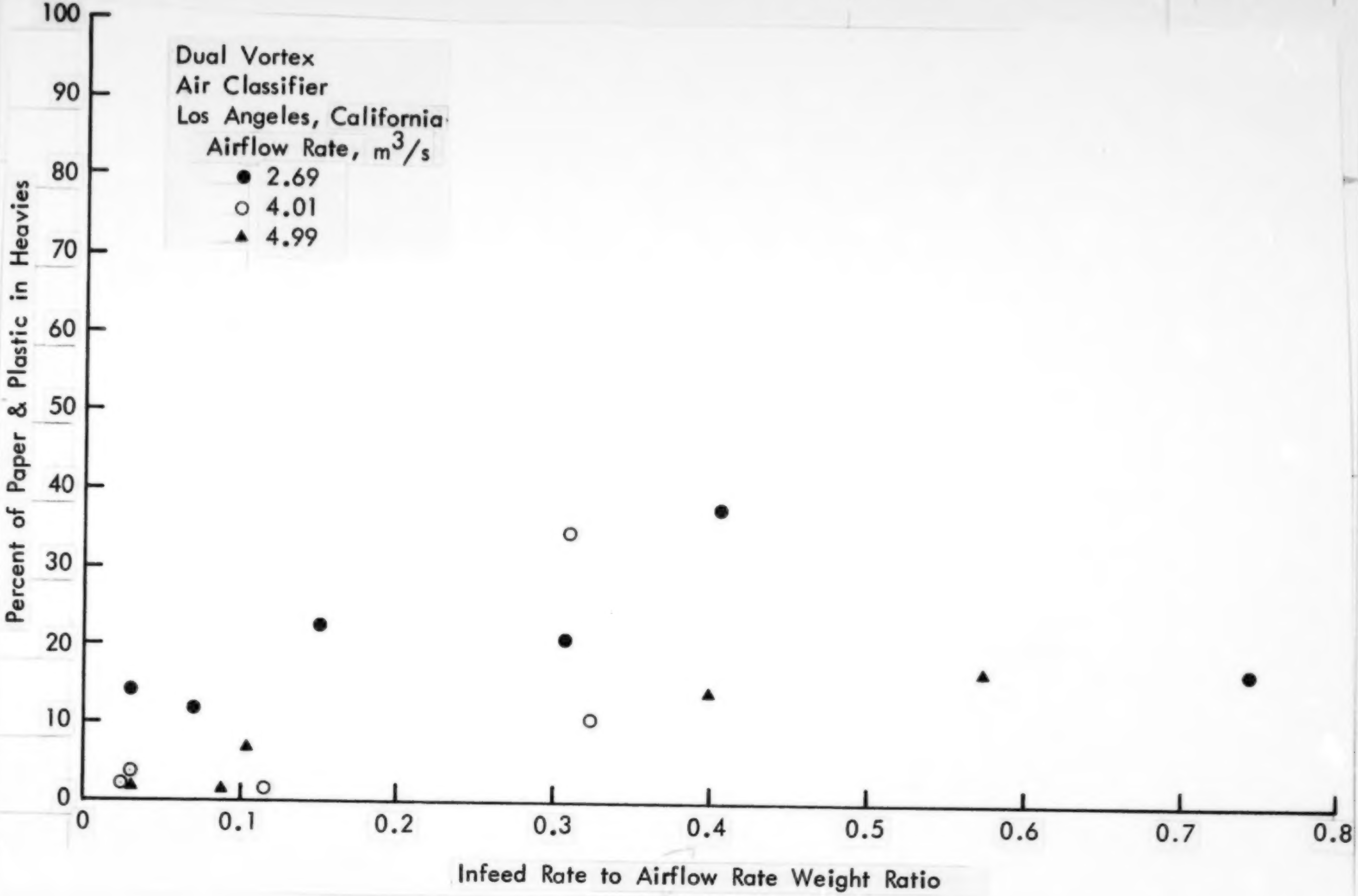

Figure 49. Percentage of paper and plastic in heavies versus solids to air weight ratio - Los Angeles, California.

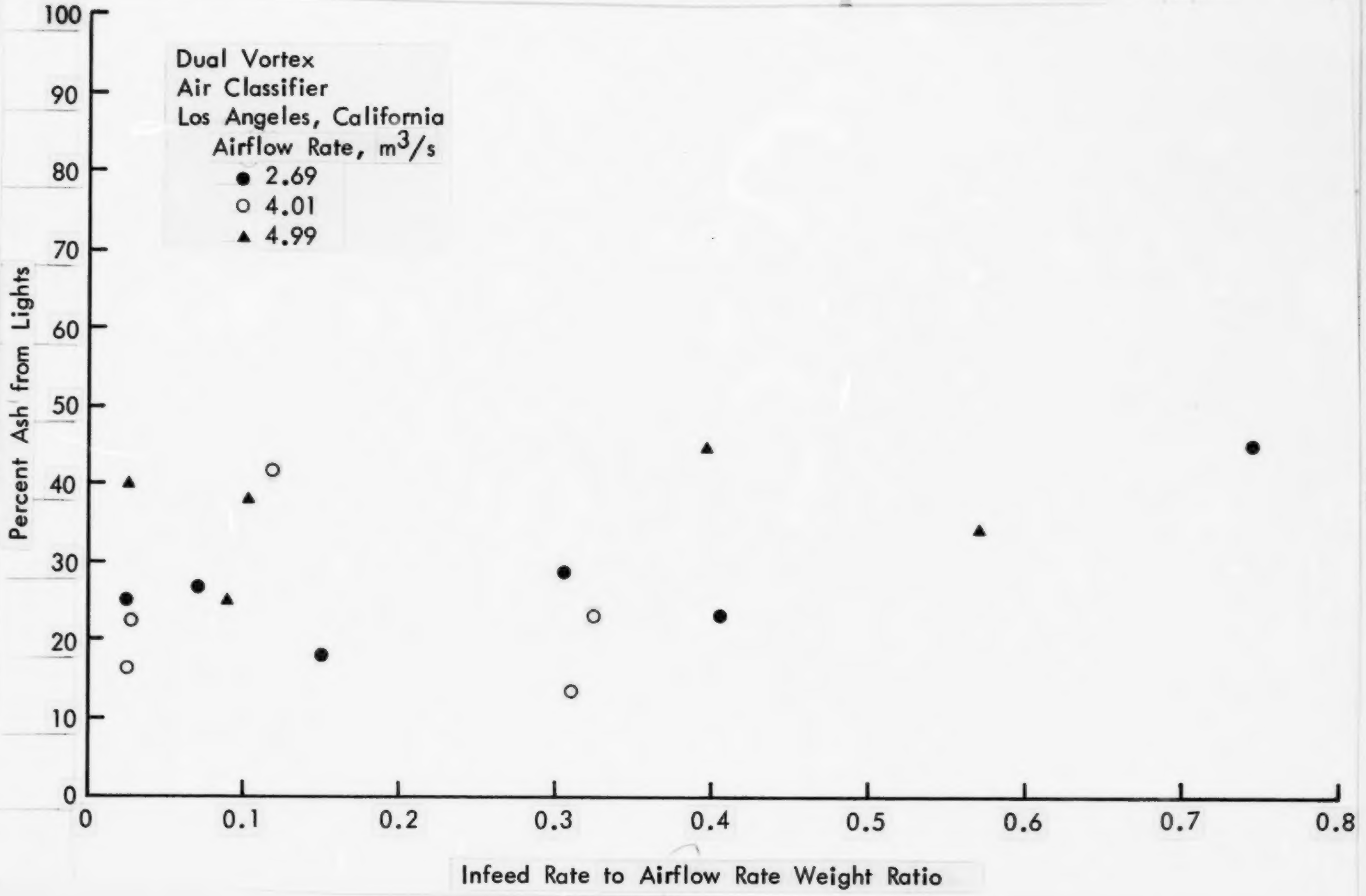

Figure 50. Percentage of ash from lights versus solids to air weight ratio - Los Angeles, California.

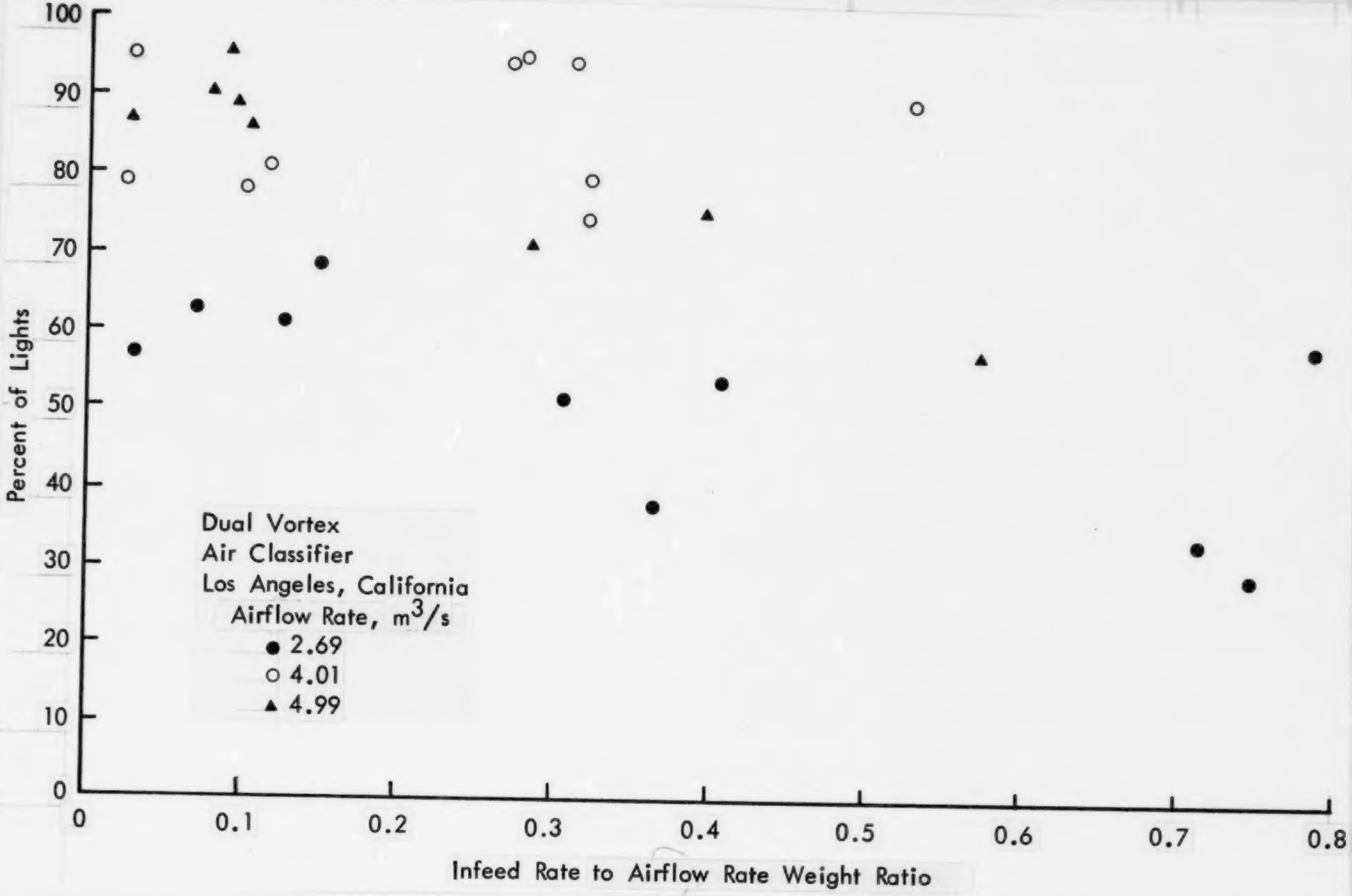

Figure 51. Percentage of lights produced versus solids to air weight ratio - Los Angeles, California.

A review of the results for the dual vortex air classifier favors operating at the middle airflow rate, though operation at the highest airflow rate would be acceptable. Even though the noncombustible carryover was somewhat greater than with the highest airflow rate, the percentage of RDF yield from the MSW infeed was noticeably higher. The specific energy consumption was also somewhat lower and could be reduced by placing an airflow restrictor on the inlet rather than outlet side of the blower. Operation at the middle airflow rate setting should also be superior in handling surges of infeed in excess of rated capacity.

The average oven dry heating value for the eight samples analyzed for heating value was 18,748 kJ/kg for the lights and 10,722 kJ/kg for the heavies, a 42.8% difference. Therefore light fraction energy recovery was higher than light fraction material weight recovery. Percentage of total energy contained in the infeed recovered by the air classifier in the light fraction varied between 96.2 and 40.7% and is plotted in Figure 52. The trend is that the higher percentage energy recoveries occur at the lower infeed flow rates and the higher airflow rates.

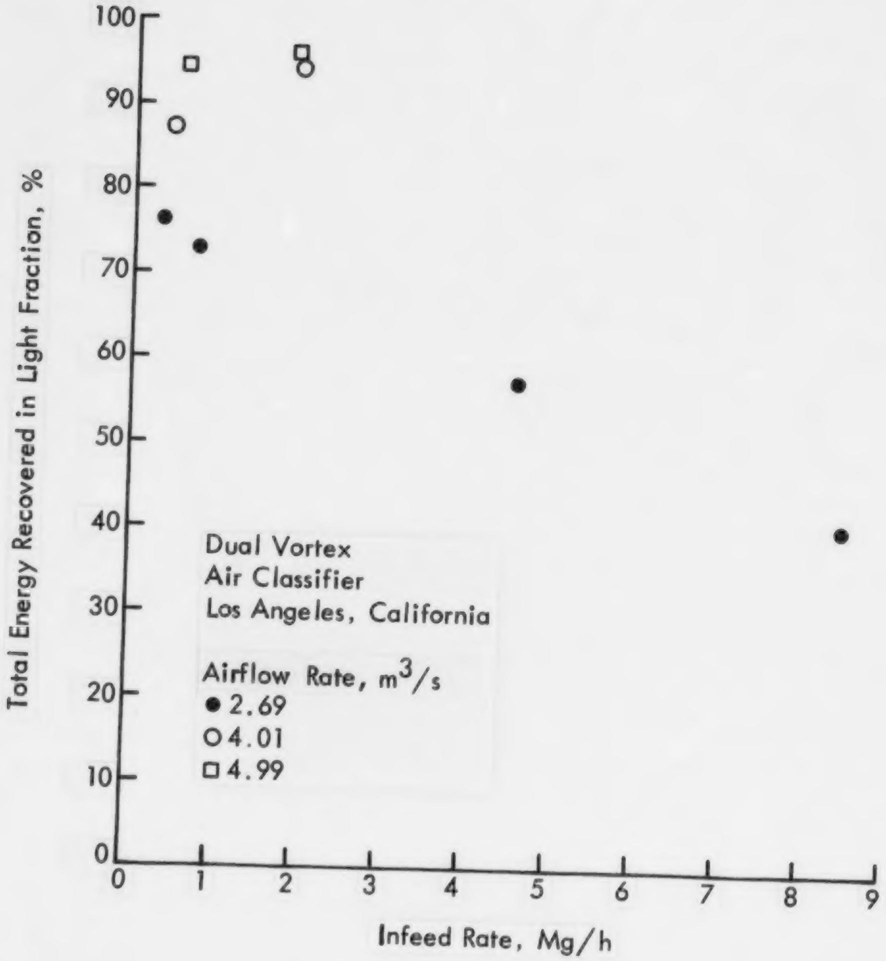

Figure 52. Energy recovery versus infeed rate - Los Angeles, California.

VIBRATING FLUIDIZED BED AIR CLASSIFIER--AKRON, OHIO

General Description of Refuse Plant

The Akron resource recovery facility is a continuously operating system that processes municipal solid waste at a maximum rate of 127 Mg/h (140 ton/h) for use in supplying fuel to two steam boilers. When completed the facility will also include two turbine driven electric generating systems. Steam from the boilers will be used for electric power generation; excess steam will be sold to steam users located in the vicinity of the facility.

The MSW processing portion of this facility is shown schematically in Figure 53. The MSW processing system includes: a tipping floor and storage pit, two identical shredders, two identical air classifier systems, a magnetic separator, a refuse-derived fuel storage bin, and necessary interconnecting conveyors. The two air classifier systems are independent and parallel. A separate shredder unit shreds MSW for each air classifier system.

A material flow diagram is shown in Figure 54. In operation, packer trucks bring MSW to the tipping floor and dump their loads into the storage pit. Material is pushed to the conveyors which feed the shredders; hazardous and difficult-to-process materials are picked out of the storage pit ahead of the shredder conveyor. The shredded material is delivered to the air classifier by an inclined conveyor which is powered by a variable speed drive for controlling the infeed rate to the air classifier. A surge bin at the bottom of the conveyor ensures that the flights on the conveyor are fully loaded. A scalping roller levels the burden on the conveyor. As material flows through the air classifier it is separated into a heavy and light fraction. The air classifier continuously vibrates predominantly in the vertical direction, and fluidizing airflow is injected at two points on the inclined portion of the air classifier bottom. The vibration and fluidization features are thought to break up clumps of shredded MSW and promote separation of heavies and lights. The heavy material drops out the heavies chute of the air classifier onto a conveyor and is transported to a ferrous separation unit. Ferrous material is then delivered to a storage bin for subsequent sale to a scrap dealer. The nonferrous material is collected for transporting to a landfill. The lights are carried upward from the air classifier and over to a cyclone which drops the lights onto a conveyor belt above the RDF storage unit. RDF withdrawn from this large storage unit is directed into a system which feeds RDF to the boiler (see Figure 53).

Air Classifier System

The major components of the air classifier system shown in Figure 55 include the air classifier unit, material handling fan, cyclone equipped with a fire control gate, return airflow baghouse, and interconnecting duct work. The air classifier unit has a bottom which slopes downward to the heavies discharge chute. The bottom slope decreases about one-third of the total bottom length from the discharge chute. The entire body of the unit is mounted on springs and caused to vibrate predominantly in a vertical direction by eccentric weights on a driven horizontal shaft.

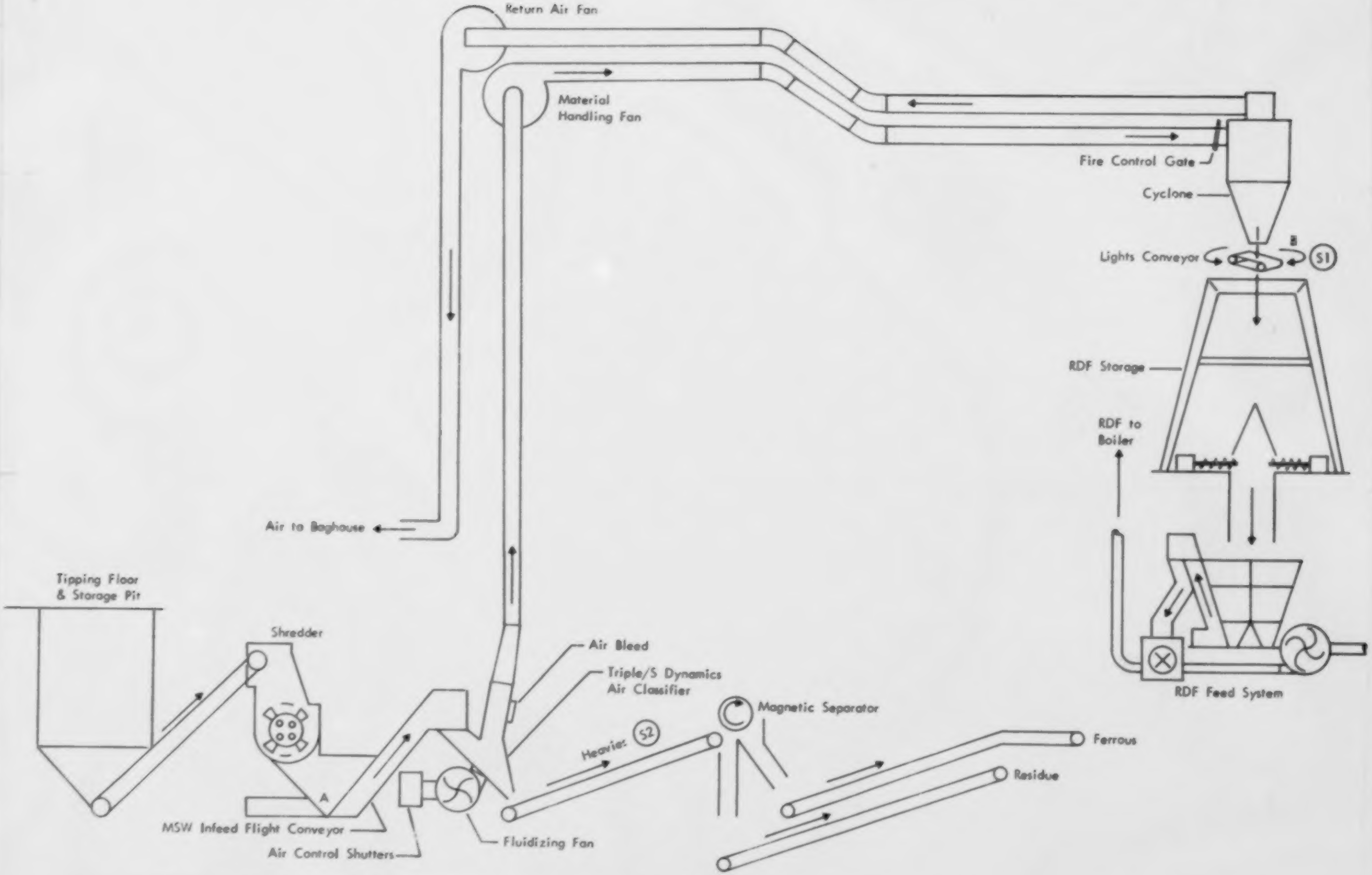
Return Air Fan
Material Handling Fan
Fire Control Gate
Cyclone
Lights Conveyor
B
S1
RDF Storage
RDF to Boiler
RDF Feed System
Air to Baghouse
Tipping Floor & Storage Pit
Shredder
Air Bleed
Triple/S Dynamics Air Classifier
Magnetic Separator
Heavies
S2
Ferrous
Residue
A
MSW Infeed Flight Conveyor
Air Control Shutters
Fluidizing Fan

Figure 53. Schematic diagram of municipal solid waste processing portion of the Akron, Ohio, resource recovery facility.

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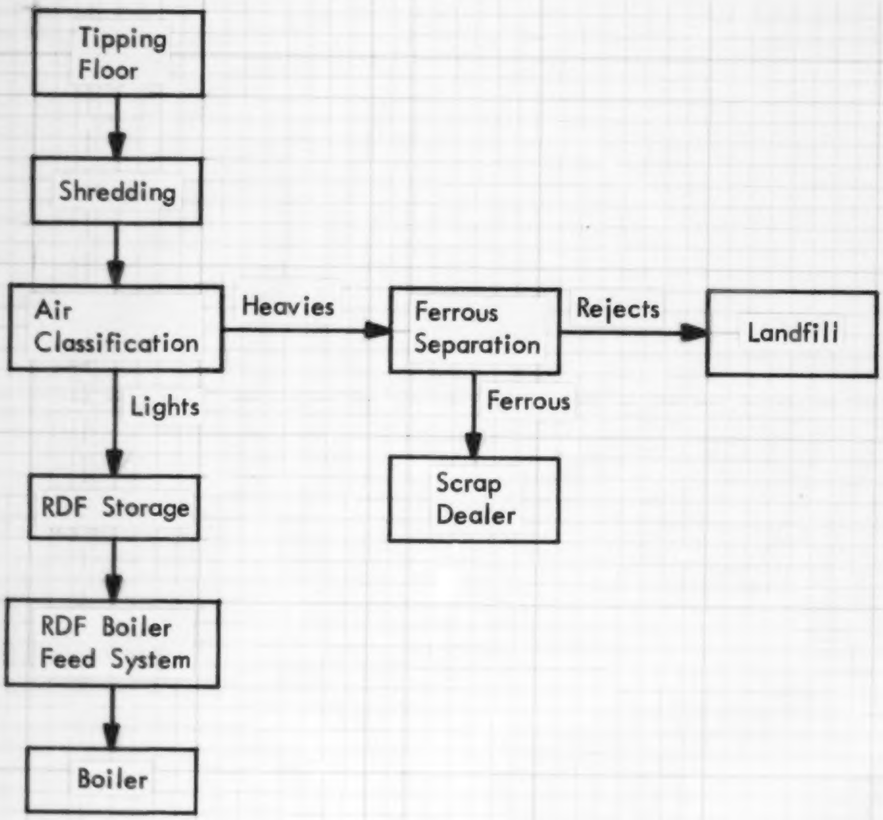
Tipping Floor
Shredding
Air Classification
Heavies
Ferrous Separation
Rejects
Landfill
Lights
Ferrous
RDF Storage
Scrap Dealer
RDF Boiler Feed System
Boiler

Figure 54. Material flow diagram - Akron, Ohio.

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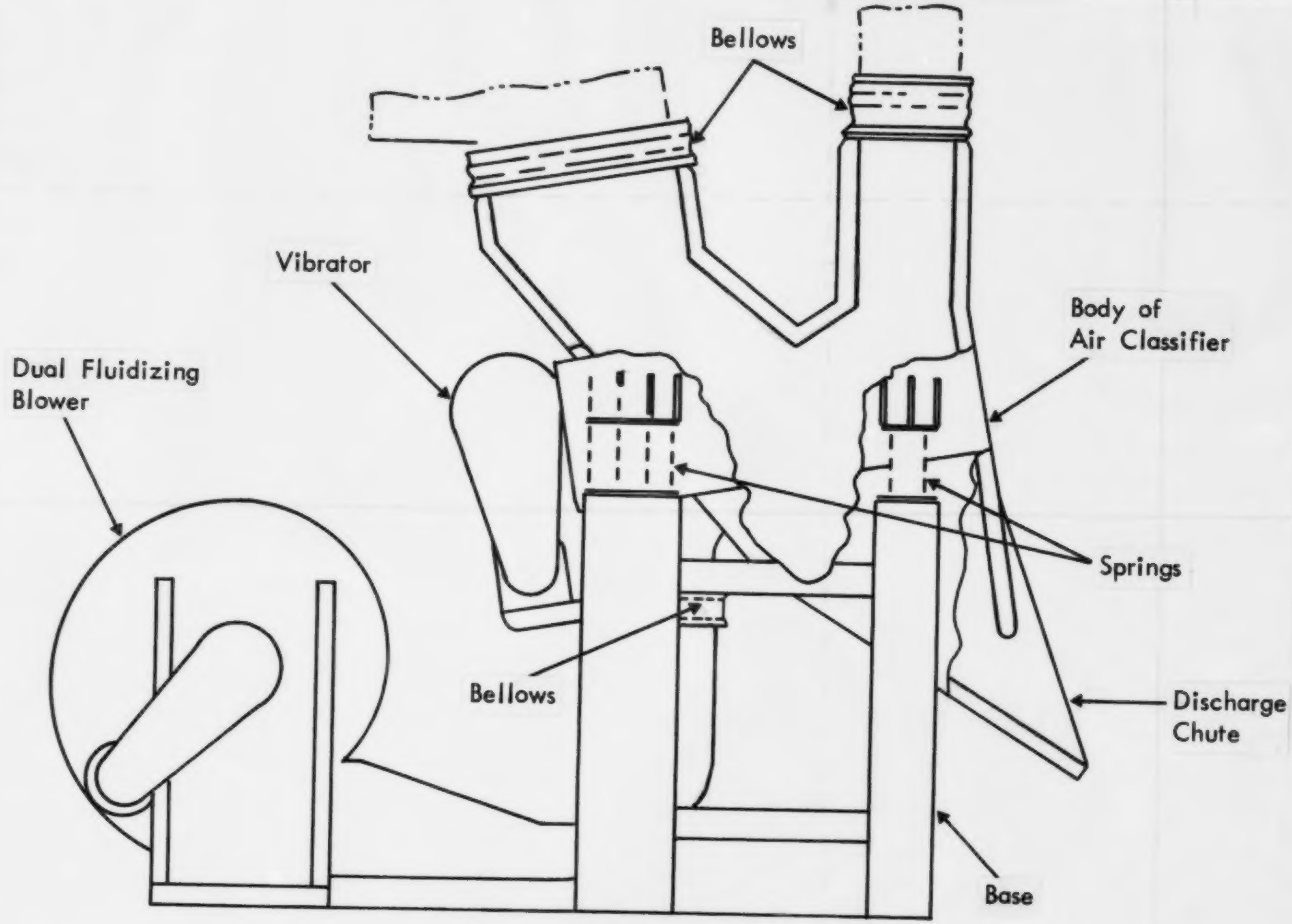
Bellows
Vibrator
Body of
Air Classifier
Dual Fluidizing
Blower
Springs
Bellows
Discharge
Chute
Base

Figure 55. Vibrating fluidized bed air classifier - Akron, Ohio.

Fluidizing air is pumped into the air classifier body at two locations in the sloping bottom. The vibrating body of the air classifier is attached to stationary connections, infeed conveyor, and duct work, with rubberized fabric type bellows.

A schematic diagram of airflow through the air classifier system is shown schematically in Figure 56. Air enters the air classifier unit through the heavies chute and through two openings in the inclined bottom of the unit (see Figure 55). A bleed air gate located in a plenum just above the air classifier unit is provided to vary airflow into the heavies chute and through the air classifier unit. Next the air passes through the material handling fan and to the cyclone. A return air fan aids the flow of air from the cyclone through the baghouse to the atmosphere. An air bleed in the return air duct is provided to reduce dynamic loads resulting from sudden drops in airflow from the cyclone.

Design Performance

Two identical air classifier systems were included in the facility and each system was designed to handle 63.5 Mg/h (70 ton/h) of shredded MSW.

Economic Data

The ASME technical paper[9] by Denclik, Hilemon, Cromblette, and Temple reported the overall cost of constructing the Akron facility. Unfortunately, the data were not subdivided into specific equipment items. The construction records show that $250,000 was the installed cost of the two air classifiers at Akron in 1977. This cost included purchase and mechanical installation of the air classifiers, the infeed conveyor, motors, fans, duct work, and the cyclone collectors at the storage bin. This cost did not include foundations and electrical installations. The cost of the foundation was included in the concrete contractor's cost for the total plant and a precise value just for the air classifier's foundation could not be extracted from the total plant cost. The same situation existed for electrical hookup whereby the electrical contractors cost was for the total plant and details for the air classifier were not available.

On the basis of the mechanical installed price of $250,000 for two air classifiers with design capacity of 63.5 Mg/h (70 ton/h) each, the capital cost was $1,969/Mg/h ($1,786/ton/h) of installed processing capacity.

Operation and maintenance costs are not available for the air classifiers because plant records were not kept specific to the air classifiers.

Results of Performance Tests

Test data were collected from only one of the two identical air classifier systems. The infeed to the shredder was set at a selected rate and the conveyor carrying MSW to the shredder was observed to be uniformly loaded.

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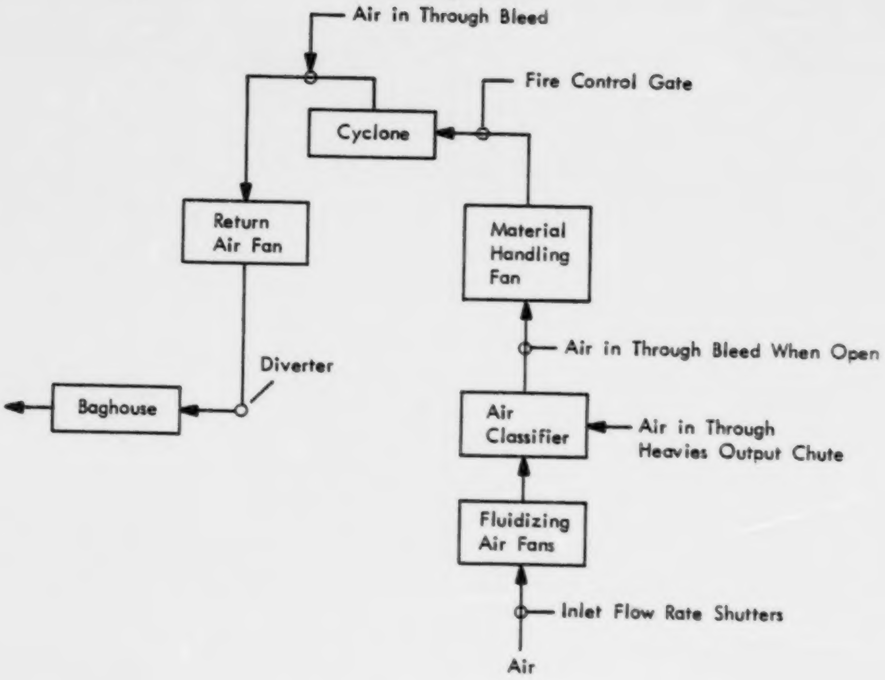
Air in Through Bleed
Fire Control Gate
Cyclone
Return Air Fan
Material Handling Fan
Air in Through Bleed When Open
Diverter
Baghouse
Air Classifier
Air in Through Heavies Output Chute
Fluidizing Air Fans
Inlet Flow Rate Shutters
Air

Figure 56. Airflow diagram - Akron, Ohio.

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TYPING GUIDE SHEET

The heavies conveyor was stopped, and after a measured lag time the lights conveyor was stopped. Samples were removed from a measured length of the lights and heavies conveyor belts. Thus the lights and heavies samples came from the same segment of the infeed stream. Next, samples were weighed and flow rates of the heavies and light stream, the infeed rate to the air classifier, and split to lights were calculated. The infeed rate was determined by adding the flow rate of the lights and heavies stream. A plot of split to lights versus infeed rate was made to select the next appropriate infeed rate. Following this procedure the infeed rate was systematically varied at each of the three airflow rates to cover the infeed rate range of interest.

Airflow rates were controlled by varying the air bleed setting. The air bleed is located on the plenum above the air classifier. Air bleed settings used during this test were at the normal setting at the plant plus one setting above and one below this setting. Airflow rates and static pressure measurements were taken at several locations in the air classifier system. Airflow rate measurements were taken at the throat of the heavies chute, the lights outlet zone in the air classifier body, and in the inlet duct to the cyclone. Pressure measurements were made in the lights zone in the air classifier body, in the duct ahead of the material handling fan, in the duct ahead of the cyclone, and in the duct ahead of the return air fan. Airflows are summarized in Table 16.

The prime movers in the system which consumed energy were the material handling blower motor, return air blower motor, air classifier vibration motor, and the motor which drove the dual fluidizing blowers.

Data obtained during the performance test are included in Tables G-1 and G-9 in Appendix G.

Concentration factors for paper plus plastic and metal at each input MSW flow rate and each airflow are shown in Table 17. This table clearly shows that the air classifier concentrates paper and plastic as well as aluminum and ferrous materials. For paper and plastic, concentration factors ranged from a low of 1.02 to a high of 1.53. The lowest concentration factor was obtained at the highest airflow rate setting whereas the highest was obtained at the middle airflow rate setting. The lowest average concentration factor was obtained at the highest airflow rate setting and the highest at the middle airflow rate setting. Concentration factors versus input feed rate tended to increase at the two highest airflow rate settings.

Concentration factors obtained for aluminum and ferrous materials were generally much higher than the factors obtained for paper and plastic. The concentration factors for the aluminum and ferrous materials ranged from 1.51 to 44.59. The lowest factor was obtained at the lowest airflow rate, whereas the highest factor was obtained at the highest airflow rate. Average concentration factors increased with increase in the airflow rate. There was no clear trend of concentration factor variation with infeed rate.

TABLE 16. SUMMARY OF AIRFLOWS FOR VIBRATING FLUIDIZED BED AIR CLASSIFIER - AKRON, OHIO

Air bleed closed	Air bleed open 5"	Air bleed open 15"
	Material Handling Duct	
63,701.13 ft^3/min	63,341.90 ft^3/min	64,237.20 ft^3/min
7,000.12 ft/min	6,960.65 ft/min	7,059.03 ft/min
2,133.66 m/min	2,121.63 m/min	2,151.62 m/min
1,803.84 m^3/min	1,793.67 m^3/min	1,819.02 m^3/min
129.18 Mg/h	127.60 Mg/h	129.43 Mg/h
	Air Classifier	
64,301.68 ft^3/min	60,802.27 ft^3/min	54,826.09 ft^3/min
4,875.03 ft/min	4,609.72 ft/min	4,156.64 ft/min
1,485.93 m/min	1,405.06 m/min	1,266.96 m/min
1,820.84 m^3/min	1,721.75 m^3/min	1,552.52 m^3/min
128.18 Mg/h	121.20 Mg/h	110.45 Mg/h
	Heavies Chutes	
	52,058.89 ft^3/min	37,534.39 ft^3/min
	4,338.24 ft/min	3,127.87 ft/min
	1,332.31 m/min	953.38 m/min
	1,474.16 m^3/min	1,062.87 m^3/min
	104.00 Mg/h	75.61 Mg/h
	Fluidizing Fan	
	8,743.38 ft^3/min	17,292 ft^3/min
	247.53 m^3/min	489.54 m^3/min
	17.2 Mg/h	34.84 Mg/h

TABLE 17. CONCENTRATION FACTORS VIBRATING FLUIDIZED BED CLASSIFIER - AKRON, OHIO

Lowest airflow rate setting[a]		Middle airflow rate setting[b]		Highest airflow rate setting[c]	
Infeed rate Mg/h	Concentration factor	Infeed rate Mg/h	Concentration factor	Infeed rate Mg/h	Concentration factor
		Paper and Plastic			
6.84	1.06	1.75	1.04	1.67	1.02
10.41	1.25	32.50	1.17	7.68	1.04
19.17	1.05	40.99	1.16	18.47	1.05
31.00	1.10	53.56	1.28	31.88	1.27
54.74	1.19	58.00	1.53	57.97	1.19
84.66	1.37				
Average	1.17	Average	1.24	Average	1.11
		Ferrous and Aluminum Materials			
6.84	11.86	1.75	24.25	1.67	44.59
10.41	4.47	32.50	5.52	7.68	6.53
19.17	10.04	40.99	5.70	18.47	12.75
31.00	9.70	53.56	2.73	31.88	3.02
54.74	2.49	58.00	1.60	57.97	2.49
84.66	1.51				
Average	6.68	Average	7.96	Average	13.88

[a] Air bleed opening set at 15 in.
[b] Air bleed opening set at 5 in.
[c] Air bleed opening set at 0 in.

The ability of the air classifier system to handle refuse for each airflow rate is shown in Figure 57. A plot of the light fraction production versus the infeed rate to the air classifier is given in this figure. The data for each airflow rate show a uniform increase in the production of lights and with infeed rate. A transition zone where increased infeed caused a substantial change in the output of the light fraction was encountered at each airflow rate. Transition zones at the low, middle, and high airflow rates were infeed rates of 25 to 30, 40 to 45, and 30 to 35 Mg/h, respectively.

These light fraction production rate curves are expected to be of significant value to the MSW facility operators. The slope of lines drawn through the data below the transition zone was essentially the same for the low and high airflow rates; the slope of the line through the data at the middle airflow rate was significantly less. The designed infeed rate of 63.5 Mg/h (70 ton/h) was above the transition zone at each of the airflow rates. The middle airflow rate had the highest transition zone, but this zone occurred at approximately 65% of design capacity.

The shape of the air classifier body coupled with air from the fluidizing fan and that drawn through the heavies chute caused a complex airflow pattern within the air classifier body. There was some evidence that air contributed by the fluidizing fan to total airflow through the air classifier body became less as more air was pulled through the heavies chute by closing the air bleed. Determining the superficial air velocity through the air classifier body in the separation zone was difficult because the separation zone was not clearly defined (see Figure 55). The operator of the system could select a preferred airflow rate and then determine the range of infeeds that produce the greatest production of lights. This selection needs to consider other factors such as energy requirements, noncombustible carry-over with lights, and RDF yield.

Electrical power requirements were measured for the material handling blower, the return air blower, and the vibrator and fluidizing blowers. Measurements were made at the three airflow rates for each prime mover and totalized for the overall air classifier system at each airflow rate (see Table G-9 in Appendix G). Total power requirements varied little because the blowers operated essentially at constant output. Power requirements were 284.1 kW at the lowest, 282.8 kW at the middle, and 282.7 kW at the highest airflow settings through the air classifier. Values of specific energy consumption are tabulated in Table 18.

Corrected ash content for the light and heavy fractions is given in Table G-1 in Appendix G. The ash content of the light fraction produced with this air classifier ranged from a low of 11% to a high of 35.5%, with an average of 23.58%. These values clearly indicate that this air classifier carried over a sizable quantity of noncombustibles along with the light fraction. The quantity of material that passed through the smallest sieve (see

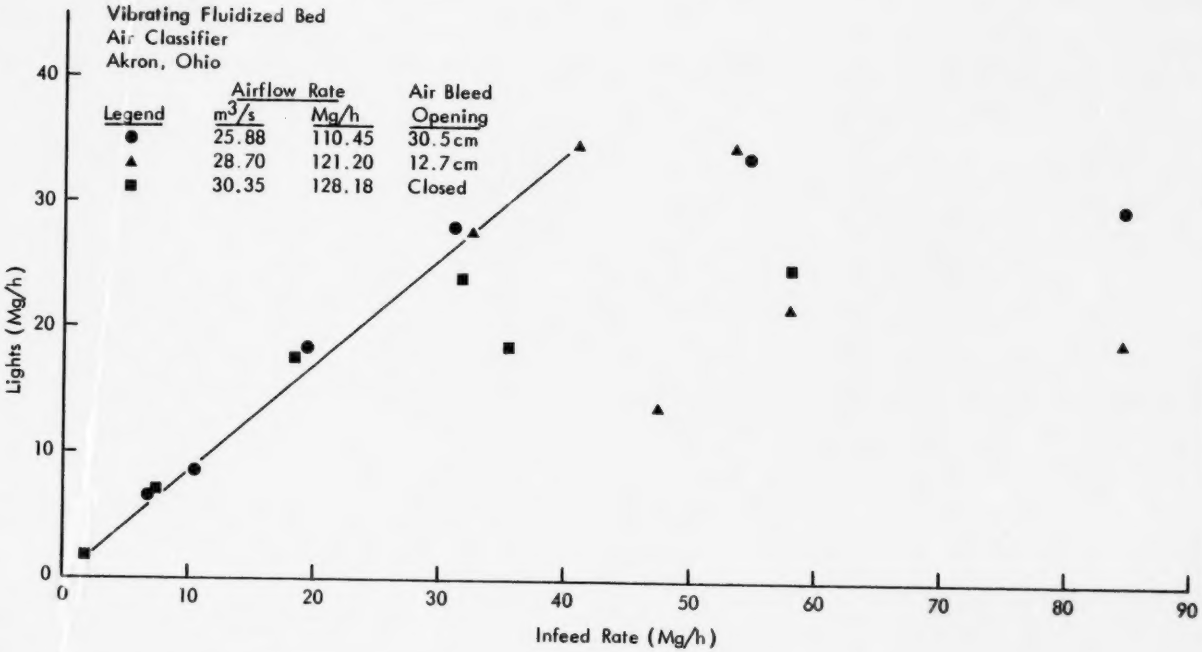

Figure 57. Lights production rate as a function of infeed rate - Akron, Ohio.

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TABLE 18. SPECIFIC ENERGY CONSUMPTION - AKRON, OHIO

Airflow setting Mg/h	Total kWh used in one hour	Infeed rate at start of transition zone Mg/h	Specific energy consumption kWh/Mg
110.45	284.1	25	11.36
121.20	282.8	40	7.07
128.18	282.7	27	10.47

Table G-6 of Appendix G) and the substantial weight in the aluminum, ferrous materials, and the "other" categories of the sample composition (see Table G-7) tend to support the statement that substantial quantities of noncombustibles were carried over with the lights. These values were sufficiently high to be of concern to a user of RDF.

Ash content in the heavy fraction was much larger than in the light fraction (see Table G-1 in Appendix G.) Ash content ranged from 41.5 to 99.6%, with an average of 66.81%.

Table 19 shows LFC for various refuse infeed rates at each airflow rate. There was no apparent trend of LFC with infeed rate at any of the three air settings (see Figure 58). The average LFC values showed a slight tendency to increase with an increase in airflow rate.

Table 20 shows RDF yield over a range of infeed rates for each of the three airflow rates. There was a definite decrease in RDF yield at the higher infeed rates. The drop-off starts in the vicinity of the light production versus infeed rate transition zone (see Figure 59). The average RDF yield values at the lowest and middle airflow rates were similar; the average value at the higher airflow rate was significantly higher.

A plot of percentage of paper and plastics in heavies versus infeed rate to airflow rate weight ratio is given in Figure 60. The percentage of paper and plastic in the heavies was generally low at first but tended to increase rapidly with increasing infeed rate to airflow rate ratios in the vicinity of the transition zone. The start of the transition zone as observed in Figure 57 was at infeed rate to airflow rate weight ratio (S/A) of 0.226, 0.357, and 0.211 for the low, high, and middle airflows, respectively. S/A values at design infeed rate of 63.5 Mg/h at the low, middle, and high airflows were 0.575, 0.524, and 0.495, respectively. It can be summarized that the middle airflow rate is preferred because it will permit operation closer to the design capacity of the air classifier than the other two before excessive quantities are rejected to the heavies stream.

TABLE 19. LIGHT FRACTION COMBUSTIBLES USING A VIBRATING FLUIDIZED BED AIR CLASSIFIER - AKRON, OHIO

Feed rate (Mg/h)	LFC (%) at airflow of 25.88 m^3/s	Feed rate (Mg/h)	LFC (%) at airflow of 28.70 m^3/s	Feed rate (Mg/h)	LFC (%) at airflow of 30.35 m^3/s
6.84	75.5	1.75	84.4	1.67	100
10.41	86.3	32.50	88.2	7.68	79.5
19.17	90.9	40.99	84.9	18.47	87.9
31.00	96.7	53.56	86.0	31.88	88.5
54.74	78.9	58.00	91.3	59.75	93.3
84.66	86.6				
Average	85.82	Average	86.96	Average	89.84

TABLE 20. REFUSE-DERIVED FUEL YIELD USING A VIBRATING FLUIDIZED BED AIR CLASSIFIER - AKRON, OHIO

Feed rate (Mg/h)	RDF-Y (%) at airflow of 25.88 m^3/s	Feed rate (Mg/h)	RDF-Y (%) at airflow of 28.70 m^3/s	Feed rate (Mg/h)	RDF-Y (%) at airflow of 30.35 m^3/s
6.84	70.90	1.75	81.47	1.67	98.09
10.41	68.83	32.50	74.44	7.68	76.26
19.17	85.86	40.99	71.77	18.47	84.03
31.00	87.29	53.56	55.50	31.88	66.50
54.74	48.47	58.00	34.13	59.75	40.10
84.66	30.36				
Average	65.28	Average	63.46	Average	73.00

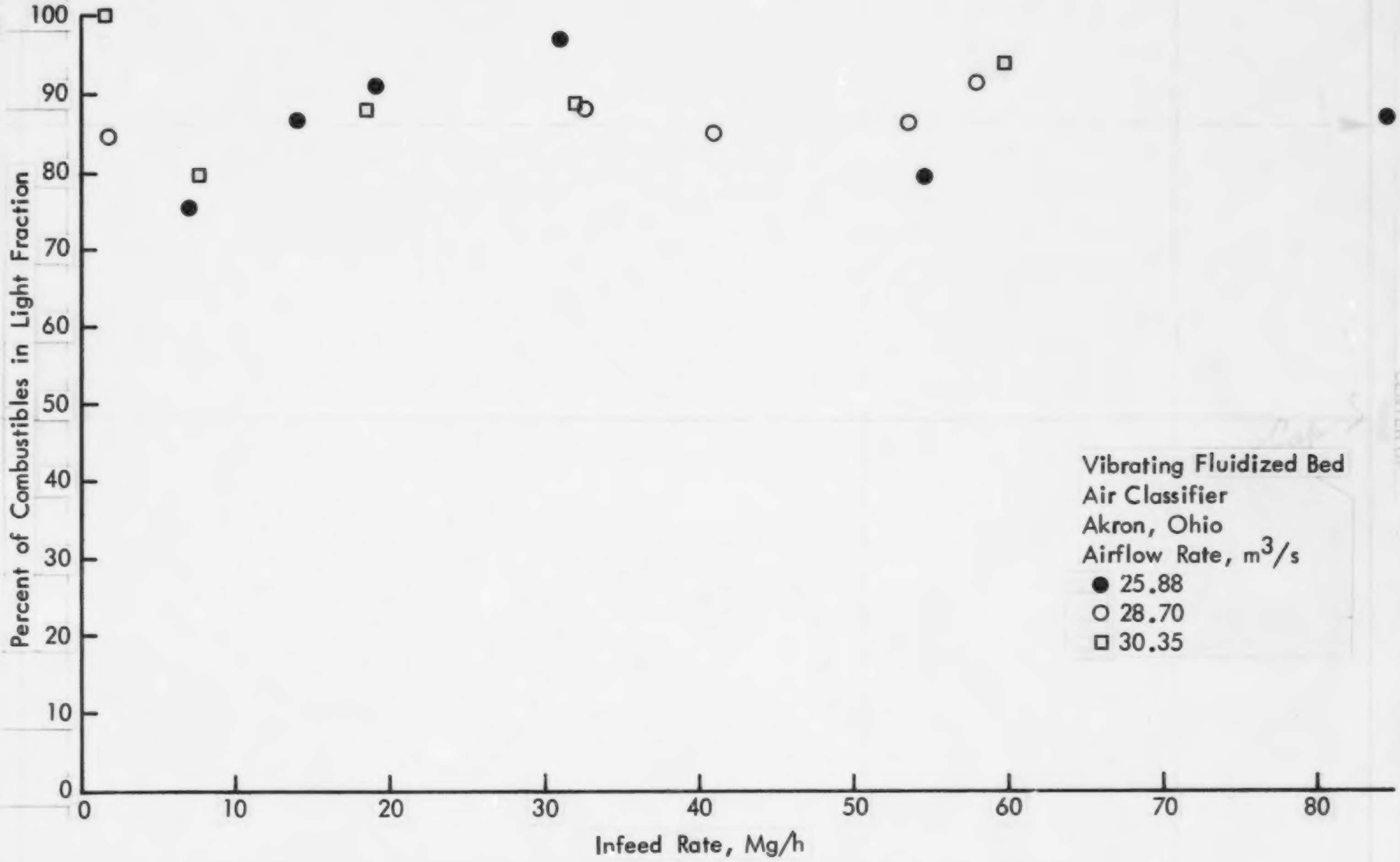

Figure 58. Percentage combustibles in light fraction - Akron, Ohio.

TYPING GUIDE SHEET

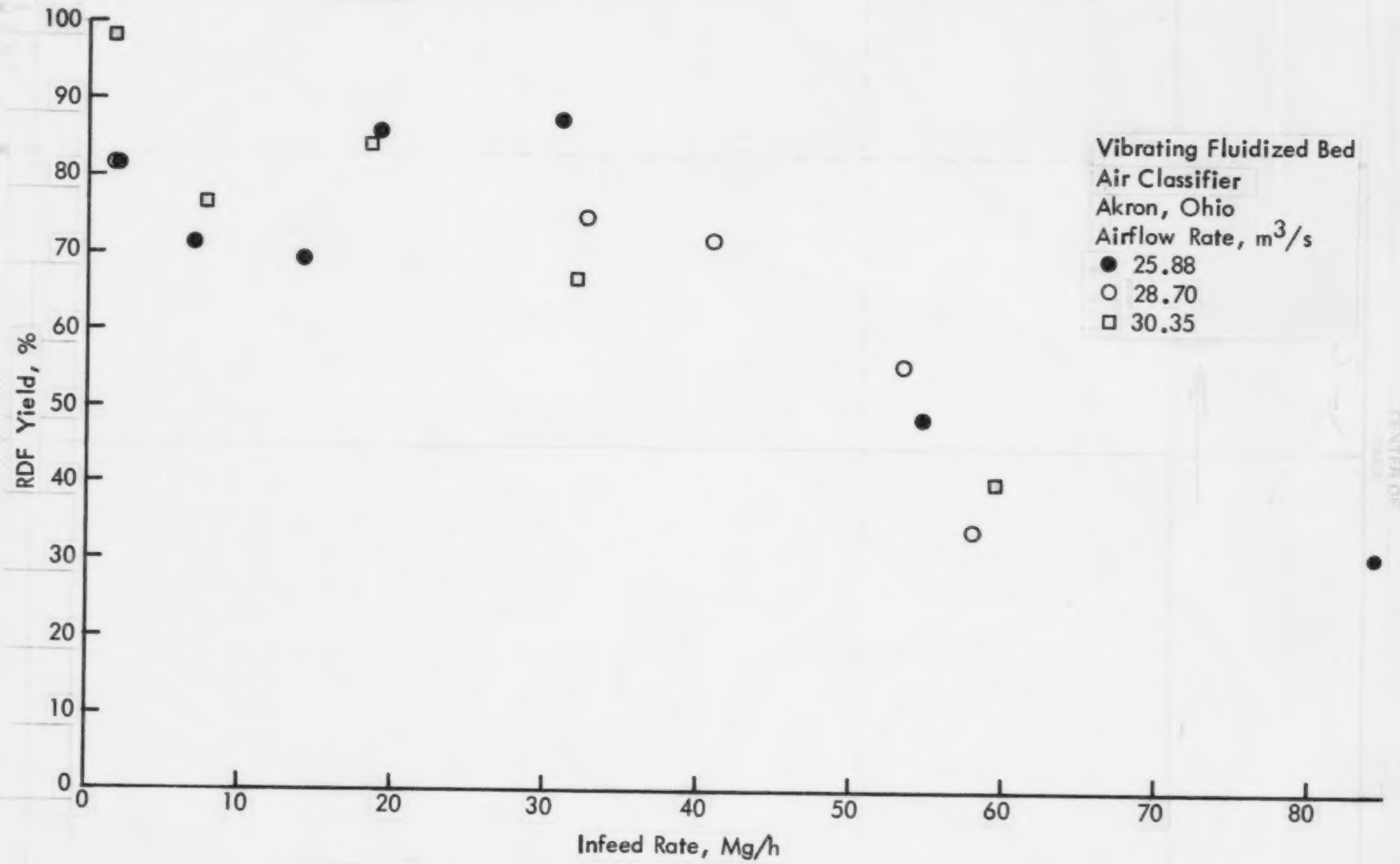

Figure 59. Refuse-derived fuel yield as a function of infeed rate - Akron, Ohio.

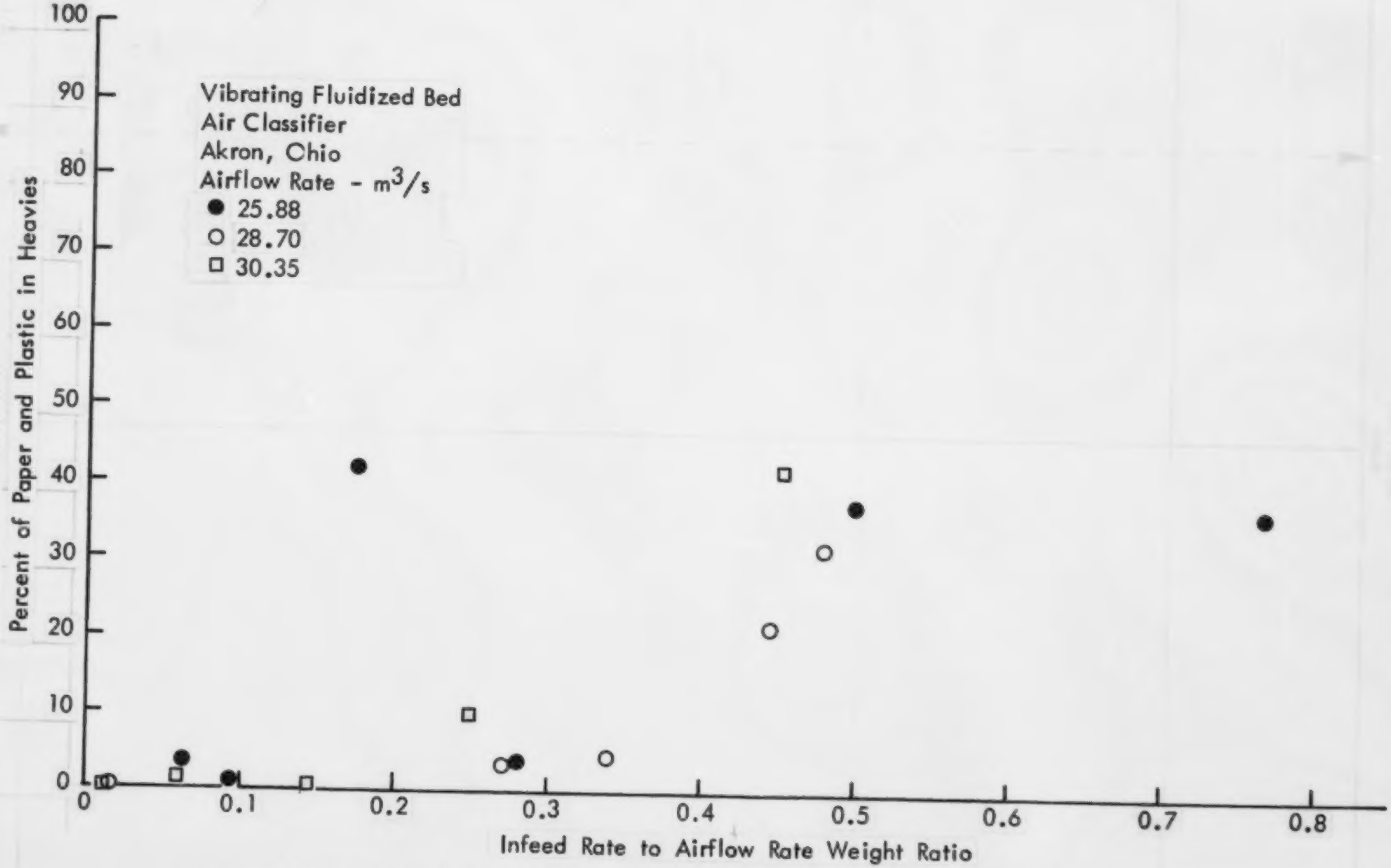

Figure 60. Percentage paper and plastic in the heavies versus solids to air ratio - Akron, Ohio.

A plot percentage of ash from lights versus infeed rate to airflow rate weight ratio is given in Figure 61. Ash from burning paper and plastic was generally in the range of 10 to 12% weight. There appeared to be little difference in the percentage of ash from one airflow rate to another over the entire operating range. Therefore a preferred airflow rate based on minimizing ash from the light fraction was not evident.

A plot of percentage of lights produced versus infeed rate to airflow rate weight ratio is shown in Figure 62. This plot shows little change in percentage of lights produced with increased infeed rate to airflow rate weight ratio until the vicinity of the transition zone was reached; beyond this region a rapid decline was evident. It is apparent that the middle airflow rate is preferred because it will permit infeeds nearer to the design capacity of the air classifier before a rapid decline in lights production is encountered.

The average oven dry heating value for the nine samples analyzed for heating value is 14,999 kJ/kg for the lights and 5,431 kJ/kg for the heavies, a 63.8% difference. Therefore light fraction energy recovery is higher than light fraction material weight recovery. Percentage of total energy contained in the infeed recovered by the air classifier in the light fraction varied between 100% and 46.9% and is plotted in Figure 63. The trend is that the higher percentage of energy recoveries occurs at the lower infeed flow rates.

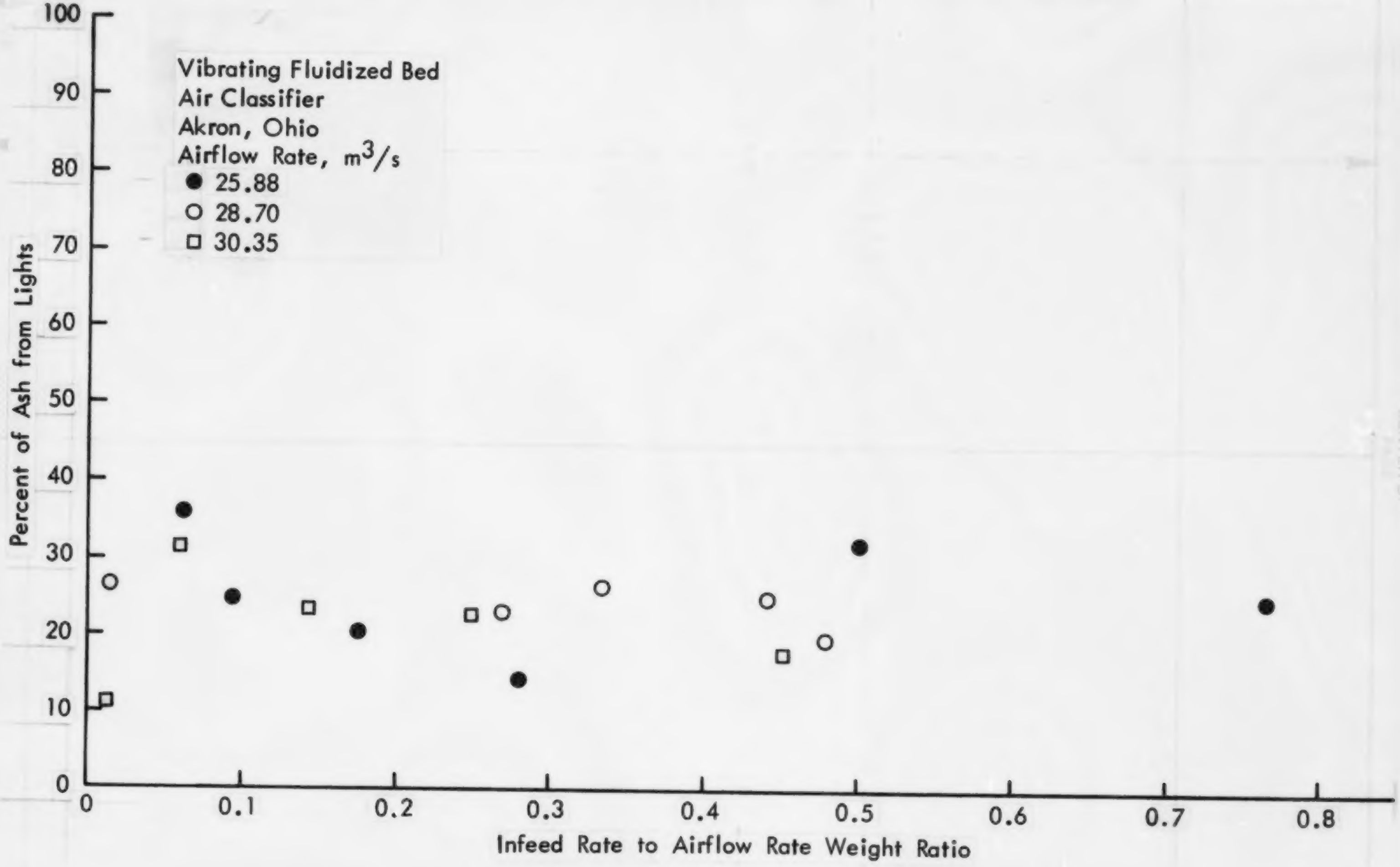

Figure 61. Percentage of ash from lights versus solids to airflow weight ratio - Akron, Ohio.

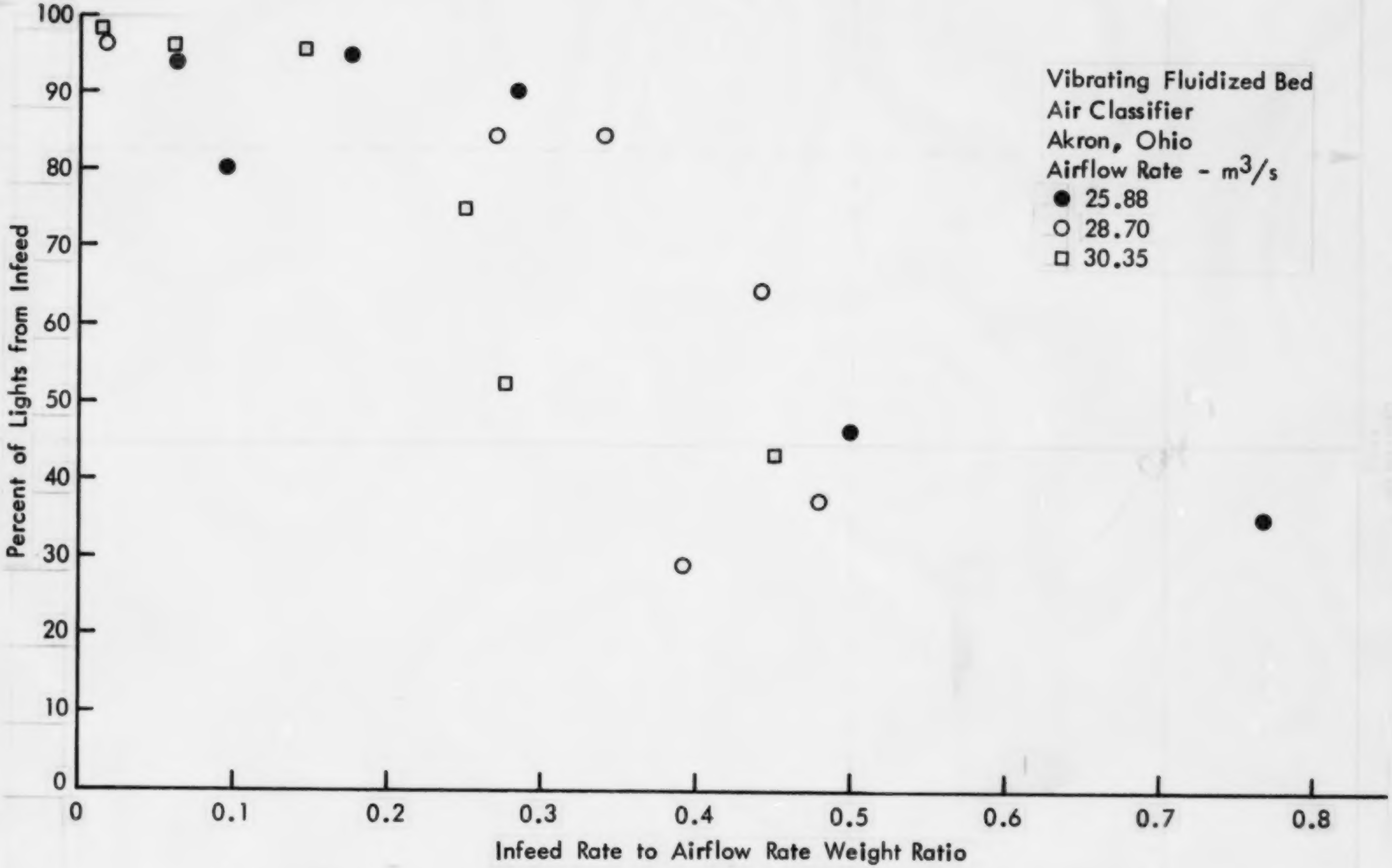

Figure 62. Percentage of infeed reporting to lights versus solids to air weight ratio - Akron, Ohio.

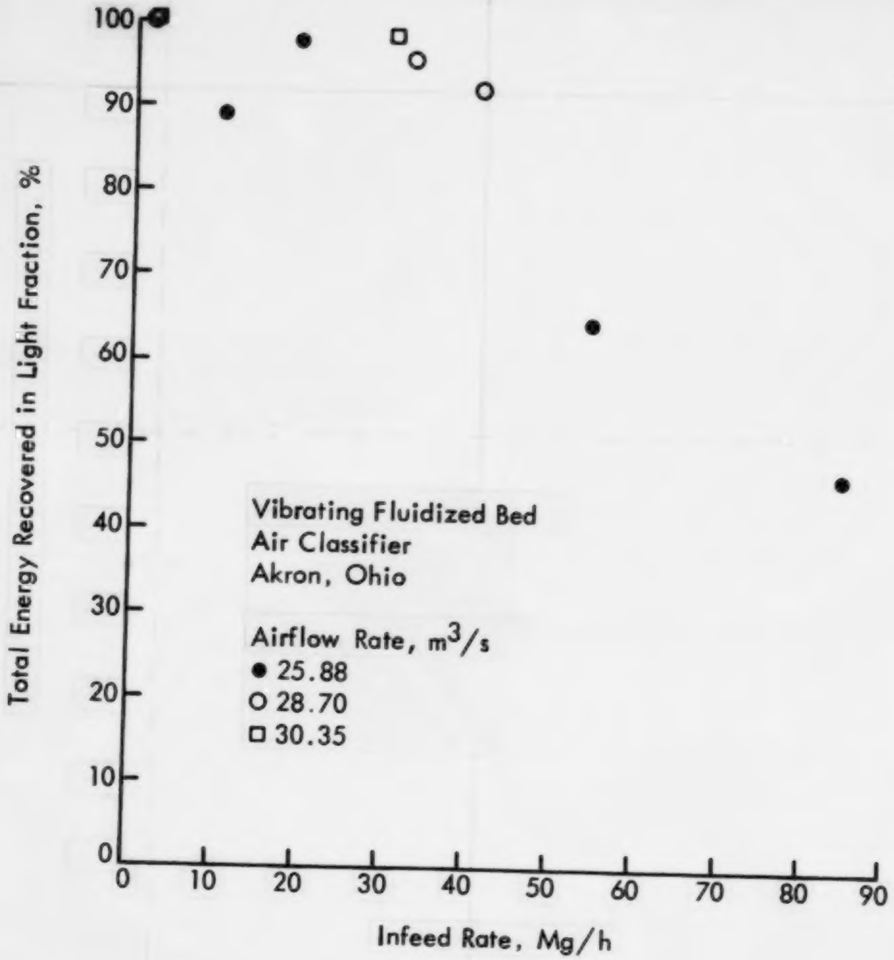

Figure 63. Energy recovery versus infeed rate - Akron, Ohio.

VIBRATING FLUIDIZED BED AIR CLASSIFIER --POMPANO BEACH, FLORIDA

General Description of RefCOM Plant

A block diagram of the overall refuse facility is shown in Figure 64. In operation MSW is trucked to the facility and dumped onto the tipping floor. The material is pushed onto a conveyor which feeds the primary shredder. Shredded refuse is conveyed to a magnetic separator. Magnetic material separated from the shredded MSW goes to a storage bin for subsequent transport to a metal salvage dealer. The remainder of the shredded material goes to landfill or to the plant. This plant is a proof-of-concept plant for converting municipal solid waste to methane and is called Refuse Conversion to Methane (RefCOM). The small air classifier was a part of the RefCOM plant.

A small fraction of the shredded MSW with ferrous material removed is diverted to a storage area of the RefCOM plant. This material is loaded onto a conveyor system as needed and to a trommel screen which removes glass, grit, and other fines. The overs which are too large to pass through the trommel screen openings are conveyed to the secondary shredder for further size reduction. This shredded material is fed into the air classifier. Heavy material is dropped out of the heavies chute and carried on a conveyor to a storage point for subsequent transport for landfill. The lights are carried on an airstream to the cyclone where they were removed from the airstream and deposited in a weigh feeder. Next the material is directed to a premix tank and then finally into one of two digesters. Gas produced by the digesters is flared. Sludge, with much of the water removed by vacuum filtration, is sent to a landfill.

Air Classifier System

The air classifier system consists of the air classifier, a cyclone, a baghouse, an induced draft blower, and interconnecting duct work (see Figure 64). A sketch of the air classifier unit is shown in Figure 65. MSW is separated into a heavy and light fraction by mechanical vibration, fluidizing with air, and a flowing airstream. Shredded MSW is dropped into the inlet to the air classifier (see Figure 65) and slides down the slanted bottom of the air classifier body. The slanted bottom, which slopes downward toward the heavies chute, becomes less steep about two-thirds of the way to the heavies chute. Mechanical vibration and fluidizing air aids the MSW movement toward the heavies discharge chute. The action of MSW promoted by vibratory motion and fluidizing air tends to move the heavies downward in the MSW sliding along the slanted bottom of the air classifier bottom. The fluidizing air also lifts the lights to the top of the sliding MSW stream where the lights can be picked up by the airstream entering the heavies chute. Heavies continue to slide along the slanted bottom of the air classifier body and drop out of the heavies chute. The lights are carried upward with the flowing airstream out the duct connected to the top front section of the air classifier body.

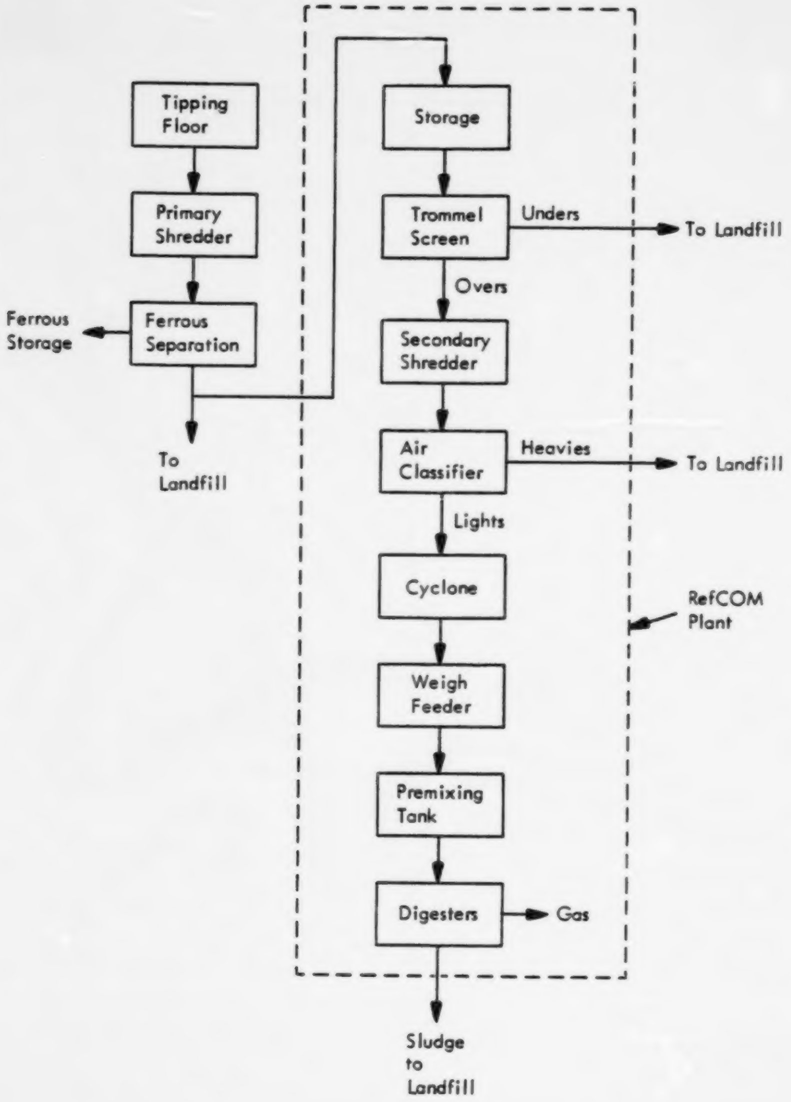
Tipping Floor
Primary Shredder
Ferrous Separation
Ferrous Storage
To Landfill
Storage
Trommel Screen
Unders
To Landfill
Overs
Secondary Shredder
Air Classifier
Heavies
To Landfill
Lights
Cyclone
RefCOM Plant
Weigh Feeder
Premixing Tank
Digesters
Gas
Sludge to Landfill

Figure 64. Material flow diagram for overall RefCOM facility - Pompano Beach, Florida.

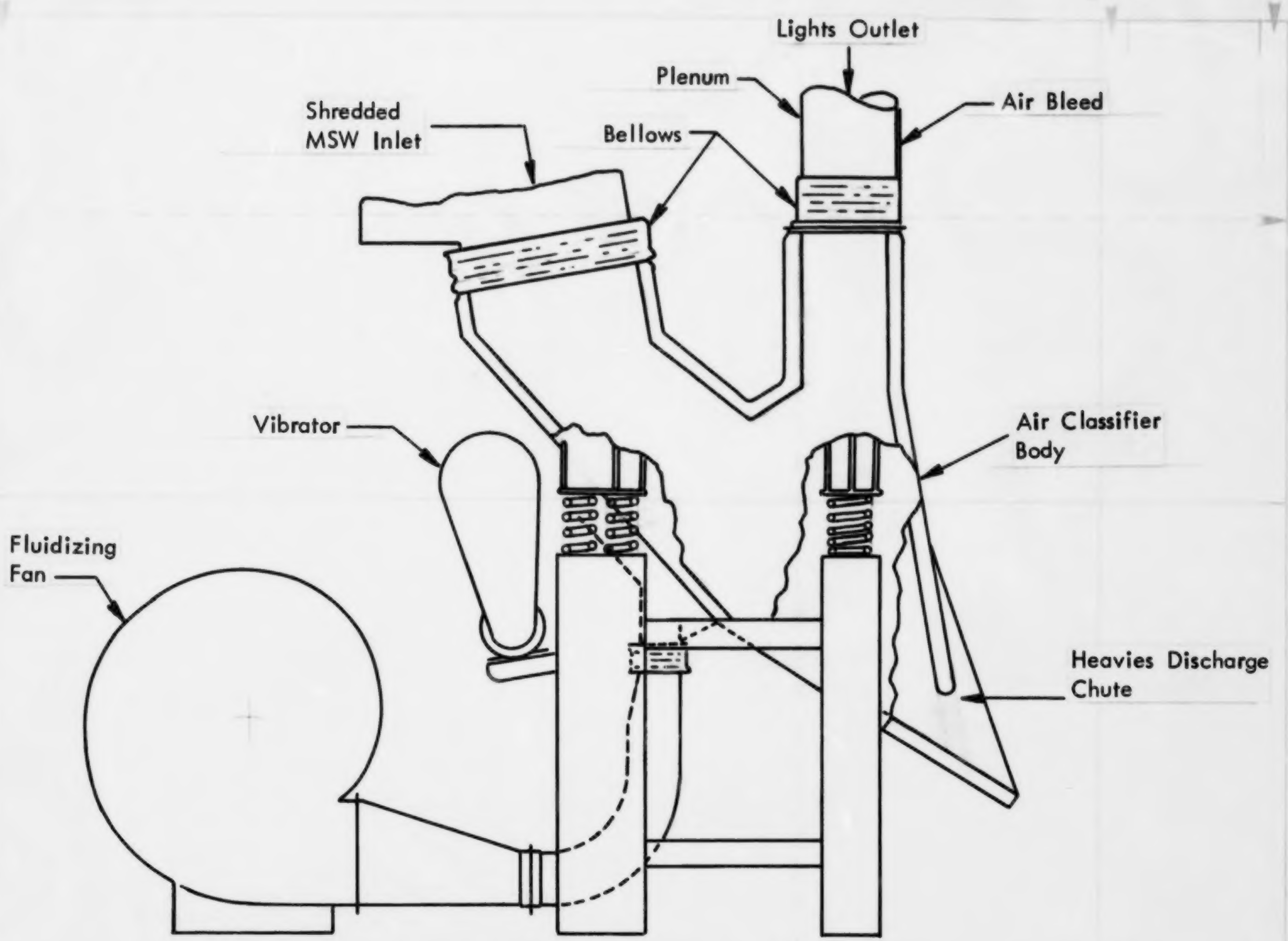
Lights Outlet
Plenum
Air Bleed
Shredded MSW Inlet
Bellows
Vibrator
Air Classifier Body
Fluidizing Fan
Heavies Discharge Chute

Figure 65. Vibrating fluidized bed air classifier - Pompano Beach, Florida.

TYPING GUIDE SHEET

Airflow through the air classifier system is shown schematically in Figure 66. Air enters the air classifier body through the fluidizing blower and the heavies chute. Air may also enter the system through an air bleed in a plenum immediately above the air classifier body. The air bleed can be set at any position from closed to full open, 21.6 cm (8.5 in). Dimensions for full open bleed are 21.6 cm (8.5 in.) high by 60.3 cm (23.75 in.) wide; the area is 0.13 m^2 (1.4 ft^2). Air flows through a duct to the cyclone and then to a baghouse. Additional air enters the baghouse from a dust control duct connected to the outlet conveyor from the secondary shredder. Air is drawn from the baghouse by an induced draft blower and then exhausted to the atmosphere.

Design Performance and Operating Experience

The air classifier was designed to handle 4.5 to 6.8 Mg/h (5.0 to 7.5 ton/h) for an average 5.7 Mg/h of secondary shredded solid waste having a nominal size of 3.81 to 5.08 cm (1.5 to 2.0 in.) and a bulk density of 64 to 120 kg/m^3 (4.0 to 7.5 lb/ft^3). The design was based on primary shredded solid waste having the composition shown in Table 21. About 70% of the primary ferrous metal is removed from this solid waste by magnetic separation before it is stored for subsequent processing by the RefCOM plant. The material is withdrawn from storage and fed to a trommel screen where 10 to 12% of the infeed material is removed which includes dirt, ash, shredded glass, and other fines. The remaining 88 to 90% is subjected to secondary shredding before being fed to the air classifier.

The air classifier system has a designed operating duty cycle of two shifts per day and 7 days per week. Design specifications of the air classifier system call for an effective air classification device to separate out heavies with adjustments to vary the degree of classification as required, an adequate pneumatic system for conveying lights from classifier to a mechanical separation system discharging into a diverter spout feeding weigh feeders, a collector for dust removal, and clean air discharge to atmosphere. Material required to drop out in the air classifier unit is to include most metals, large shredded glass and ceramic particles, heavy plastics, wood, rocks, etc. Most of the organic and paper portion of the infeed stream is to be recovered. The system is to be designed for handling abrasive materials.

The air classifier system uses electric motors built in accordance with National Electric Manufacturers Association, American Institute of Electrical Engineers, and American Standards Association standards. Electric motors in the system include a 5.6-kW (7.5-hp) unit to drive the mechanical vibration, a 14.92-kW (20-hp) unit to drive the fluidizing blower, a 2.24-kW (3-hp) unit to drive the rotary air lock at the bottom of the cyclone, a 3.73-kW (5-hp) unit to drive a screw conveyor at the bottom of the baghouse, and a 44.76-kW (60-hp) unit to drive the induced draft blower. All electric motors in the air classifier system are three-phase, 60-Hz, 460-v, totally enclosed fan cooled units made with Type B insulation and have a service factor of 1.0.

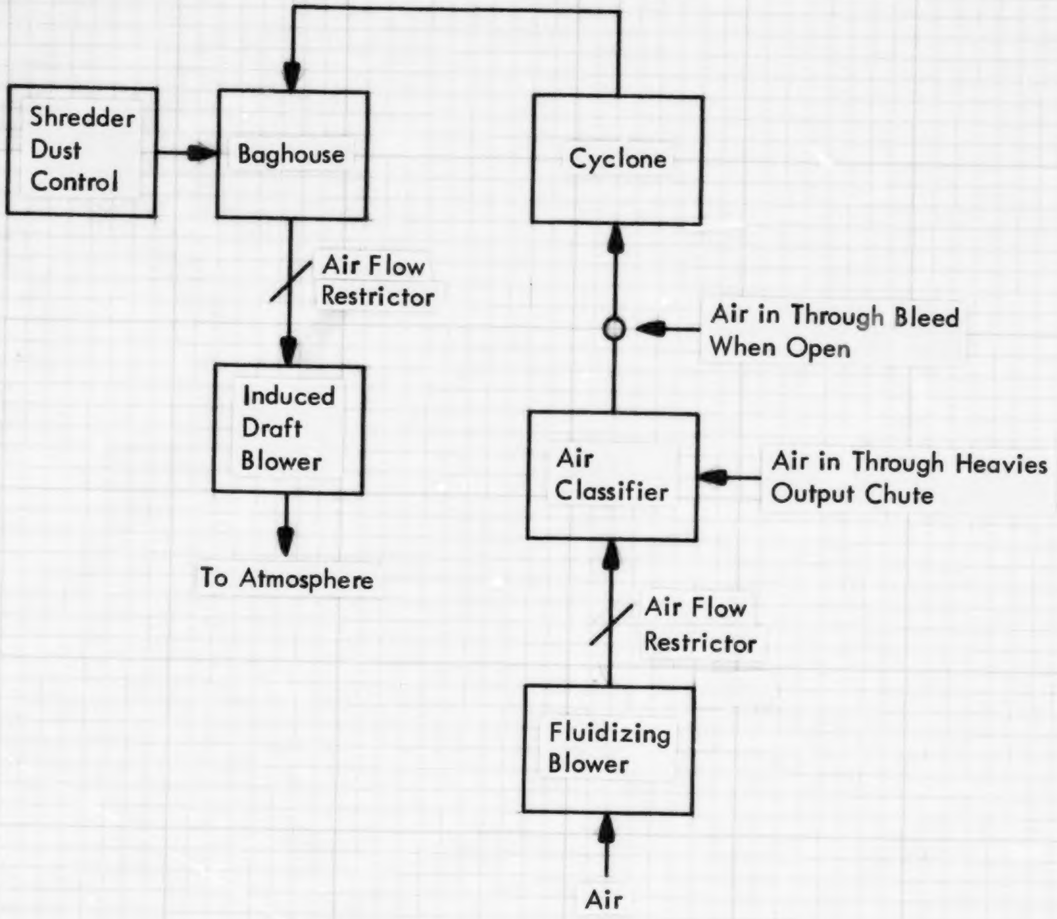
Shredder Dust Control
Baghouse
Cyclone
Air Flow Restrictor
Air in Through Bleed When Open
Induced Draft Blower
Air Classifier
Air in Through Heavies Output Chute
To Atmosphere
Air Flow Restrictor
Fluidizing Blower
Air

Figure 66. Airflow schematic for Pompano Beach, Florida, air classifier.

TABLE 21. TYPICAL ANALYSIS OF SHREDDED MUNICIPAL SOLID WASTE - POMPANO BEACH, FLORIDA, DESIGN SPECIFICATIONS

Constituent	Average % on dry basis
Food	1.7
Garden waste	3.8
Paper	38.5
PVC, rubber, leather	3.5
Textiles	2.1
Wood	2.5
Ferrous metals[a]	7.2
Nonferrous metals	1.1
Other metals	0.1
Glass, ceramics[a]	12.0
Rock, dirt, ash	0.1
Fines[a]	4.0
Moisture	23.4
Total	100.0

[a] Partial or complete removal before being fed to air classifier.

The air classifier system was designed to comply with all federal, state and local regulations and codes with particular attention given the latest OSHA and Southern Florida Building Code requirements.

The general arrangement of the air classifier system was well conceived. Locating a trommel ahead of the air classifier was very beneficial to the operation of the air classifier. Most of the grit, dirt, and pulverized glass was removed, essentially avoiding abrasion problems in the air classifier system. It was difficult to optimize the airflow rate through the air classifier system because of four adjustment points; air bleed plus restrictions on exhaust ducts for the fluidizing and main airflow can be adjusted separately. Because of the number of tests needed to determine the best settings, it is doubtful that optimized air classifier performance has ever been defined for the range infeed rate of shredded MSW used at this plant. Operating the air classifier at the upper end of the design infeed rate 4.5 to 6.8 Mg/h (5.0 to 7.5 ton/h) may cause the cyclone to jam. The air classifier system has no fire gate ahead of the cyclone to minimize fire and explosion hazards. The installation of an automatic or remotely controlled water spray system at the secondary shredder and above the conveyor belt between the shredder and air classifier should be considered. Fibrous materials, plastics, and nonferrous metals are undesirable for inclusion in the nutrients for the digesters. Techniques for removing most of these materials are needed. At least one premature bearing failure on the fluidizing blower has been encountered. The cause of this failure should be determined and steps taken to guard against further failure.

Economic Data

The 1976 cost of the air classifier system equipment including the air classifier itself, fan, motors, duct work, and baghouse was $18,756. Not included in this cost was site preparation, mechanical installation, and electrical hookup as these costs were included in the general contractor's costs which were not categorized as to specific items or systems of equipment. The rated capacity of 4.5 to 6.8 Mg/h is an average 5.7 Mg/h. The capital costs per design average capacity were $3,290/Mg/h ($2,977/ton/h). No operational and maintenance data were available because the plant records were not organized to specify the air classifier as a separate item.

Results of Performance Tests

Airflow measurements were made as described in Section 3 with the exception that the pitot tube was positioned at the exit of the heavies discharge chute to measure airflow into the heavies chute. The lights stream was sampled by collecting material from the end of a conveyor beneath the cyclone with a large heavy gauge plastic sack. The heavies stream was sampled by collecting material exiting the air classifier's heavies chute on a plastic sheet. The plastic sack and sheet were inserted at selected times and withdrawn after a specific time interval. A small wooden plank was fed into the shredder to determine the time lag between starting to take the heavies and lights sample. This was done so that samples could be taken from the same segment of infeed stream. Shredded wood is a good indicator material because part of the shredded material reports to the lights and the remainder reports to the heavies. In addition, splintered wood can be readily identified. Sample weights were measured with a small platform scale to the nearest 28 g (1 oz). Two techniques were used to obtain the desired infeed rates at each of the three airflow rates. One was to vary the speed that the hopper fed material onto the trommel inlet conveyor; the second was to uniformly load the trough conveyor between the shredder and air classifier to selected depths and then feed this material into the air classifier using a constant conveyor speed. The second loading technique was necessary to obtain the higher infeed rates.

Data obtained during the performance test are included in Tables H-1 and H-9 in Appendix H.

Lights were separated from the vibrating and fluidized stream of twice shredded MSW and carried away by air flowing through the air classifier. A knowledge of this airflow is beneficial in understanding air classifier performance. Airflows at each air bleed setting with no shredded MSW in the system is summarized in Table 22. This table shows airflow rates, mass and volume, into the heavies chute, into the air bleed, into the fluidizing blower, through the dust control duct, and through the induced draft blower. Values in the table do not consider possible leakage into the system. Pitot tube measurements are considered to be accurate to ± 2.5% except for airflow into the heavies discharge chute. Accuracy of locating the pitot tube tip in the chute opening is expected to more than double the inaccuracy of measuring airflow into the heavies discharge chute as compared to the other measurements.

It is apparent that most of the air which flows into the air classifier body is supplied by the fluidizing fan. However, the location of the fluidizing vents makes it unlikely that all of the fluidizing air contributes to the lights being lifted into the airstream in the separation zone. The air classifier shape confounds identifying the zone where lights are separated from the infeed stream. Therefore superficial air velocity in the separation zone cannot be determined from the airflow rate data.

Concentration factors for paper plus plastic and metal at each input MSW flow rate and each airflow are shown in Table 23. This table shows that the air classifier concentrates paper and plastic as well as aluminum and ferrous materials. Concentration factors for paper and plastic ranged from a low of 1.00 to a high of 1.11. The lowest concentration factor was obtained at the lowest airflow rate setting, whereas the highest was obtained at the highest airflow rate setting. The lowest average concentration factor was obtained at the lowest airflow rate setting and the highest at the highest airflow rate setting. There did not appear to be a trend of concentration versus input feed rate at any of the three airflow rates tested.

TABLE 22. SUMMARY OF AIRFLOW THROUGH AIR CLASSIFIER SYSTEM - POMPANO BEACH, FLORIDA

Air bleed setting cm (in)	Heavies chute Mg/h	Fluidizing fan Mg/h	Air classifier plenum Mg/h	Air bleed Mg/h	Dust control duct Mg/h	Inlet to induced draft blower Mg/h
0(0)	5.09	19.60	24.69	0.00	1.57	25.54
10.8(4.25)	3.36	17.16	20.52	3.90	1.45	25.87
21.6(8.50)	3.01	14.64	17.65	6.64	1.54	25.83
(cm(in))	$(m^3/min)^a$	$(m^3/min)^b$	$(m^3/min)^a$	$(m^3/min)^b$	$(m^3/min)^a$	$(m^3/min)^a$
0.(0)	71.20	247.90	346.10	0.00	21.98	369.69
10.8(4.25)	46.93	240.59	287.52	66.73	20.30	374.55
21.6(8.5)	42.12	204.98	247.10	105.37	21.58	374.05

[a] Airflow in m^3/min is at condition of pressure and moisture content of air at measurement location.

[b] No corrections made for conditions of pressure and moisture content of air in determining these values.

TABLE 23. CONCENTRATION FACTORS FOR VIBRATING FLUIDIZED BED AIR CLASSIFIER - POMPANO BEACH, FLORIDA

Lowest airflow rate setting 4.12 m^3/s[a]		Middle airflow rate setting 4.79 m/s[a]		Highest airflow rate setting 5.77 m^3/s[a]	
Infeed rate Mg/h	Concentration factor	Infeed rate Mg/h	Concentration factor	Infeed rate Mg/h	Concentration factor
		Paper and Plastic			
0.93	1.02	0.62	1.02	0.25	1.11
1.31	1.01	1.03	1.05	1.00	1.03
1.32	1.02	1.44	1.02	2.38	1.03
4.93	1.00	3.62	1.03	5.56	1.10
6.61	1.07	4.05	1.07	10.79	1.10
Average	1.02	Average	1.04	Average	1.07
		Ferrous and Aluminum Materials			
0.93	2.43	0.62	11.73	0.25	6.91
1.31	3.10	1.03	5.88	1.00	6.50
1.32	4.82	1.44	5.66	2.38	4.48
4.93	1.29	3.62	2.95	5.56	1.78
6.61	1.41	4.05	1.90	10.79	1.20
Average	2.61	Average	5.62	Average	4.17

[a] Airflow rates measured in the air classifier plenum.

Concentration factors obtained for aluminum and ferrous materials were much higher than the factors obtained for paper and plastic. The concentration factors for the aluminum and ferrous materials ranged from 1.20 to 11.73. The lowest factor was obtained at the highest airflow rate setting, whereas the highest factor was obtained at the middle airflow rate. The lowest average concentration factor occurred at the lowest airflow rate setting and the highest at the middle airflow rate setting. There was no clear trend of concentration factor variation with infeed rate at the lowest airflow rate setting, but concentration factors decreased with infeed rate at the middle and highest airflow rate setting.

The ability of the air classifier system to handle refuse for each airflow rate is shown in Figure 67. A plot of the light fraction production versus the infeed rate to the air classifier is given in this figure. The data for each airflow rate showed a uniform increase in the production of lights and with infeed rate. A transition zone where increased infeed causes a substantial change in the output of the light fraction was experienced at all three airflow rates.

The transition zones occurred at infeed rates of 4.0 to 5.0 Mg/h, 3.0 to 4.0 Mg/h, and 6.5 to 7.5 Mg/h at the lowest, middle, and highest airflow rates, respectively. The occurrence of the lowest transition point at the middle airflow rate was unexpected. Two possible explanations for this unexpected air classifier behavior are: (a) there was greater interaction between the fluidizing air and the air entering the chute than at the lowest airflow rate, or (b) there was significant variation in the characteristics of the MSW entering the air classifier during test runs at the lowest and middle airflow rates. Additional tests are required to develop a definitive explanation. From the standpoint of separating a light fraction from shredded MSW, it can be deduced from Figure 67 that the highest airflow rate is preferred. Even at the highest airflow rate the top part of the rated air classifier capacity of 6.8 Mg/h (7.5 ton/h) will be above the transition zone.

Electrical power requirements were measured and totalized for the overall air classifier system at each airflow rate (see Table H-9 of Appendix H). Power requirements at each airflow rate were essentially the same. Power requirements were 49.12 kW at the lowest airflow rate, 48.90 kW at the middle airflow rate, and 49.12 kW at the highest airflow rate. Specific energy consumption values are tabulated in Table 24. The highest specific energy consumption was observed at the middle airflow rate setting, whereas the lowest specific energy consumption was observed at the highest airflow.

Corrected ash content for the light and heavy fractions is given in Table H-1 of Appendix H. The ash content of the light fraction produced with this air classifier ranged from a low of 6.7% to a high of 17.3%, with an average of 10.17%. These values indicate little if any noncombustibles were carried over along with the light fraction since ash from burned paper and plastic can be expected to be in the range of 10 to 12%.

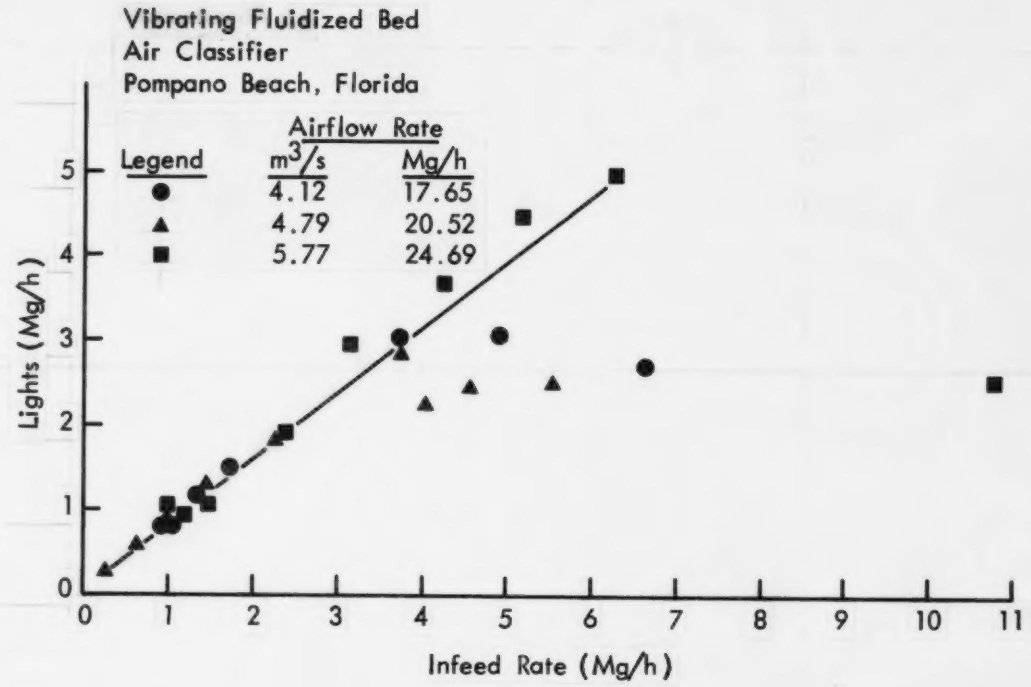

Figure 67. Lights production rate as a function of infeed rate - Pompano Beach, Florida.

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TABLE 24. SPECIFIC ENERGY CONSUMPTION - POMPANO BEACH, FLORIDA

Airflow rate[a] Mg/h	Total kWh used in one hour	Rated or transition zone infeed rate Mg/h	Specific energy consumption kWh/Mg
17.65	49.12	4.4-5.5[b]	11.16- 8.93
20.52	48.90	3.5-4.0[b]	13.97-12.23
24.69	49.12	5.0-5.5[b]	9.82- 8.93

[a] Airflow through air classifier plenum (see Table 2).
[b] Infeed rate in transition zone.

Ash content in the heavy fraction is much larger than in the light fraction (see Table H-1 in Appendix H). Ash content ranged from 12.0 to 58.0% with an average of 22.3%.

Table 25 shows LFC for various refuse infeed rates at each airflow rate. The ash content of several samples was less than the 11% ash normally expected. Whenever the ash content was 11% or less, the LFC was considered to be 100%. This particular plant used a trommel screen ahead of the air classifier which removed most of the grit, glass, and small metal particles from the infeed stream. The level of the LFC is a clear indication that the trommel screen raised the quality of RDF produced by the plant. LFC was high at each airflow rate over the range of infeed rates tested (see Figure 68). The highest LFC was at the lowest airflow rate and the lowest LFC at the highest airflow rate.

TABLE 25. LIGHT FRACTION COMBUSTIBLES USING A VIBRATING FLUIDIZED BED AIR CLASSIFIER - POMPANO BEACH, FLORIDA

Feed rate (Mg/h)	LFC at airflow of 4.12 m^3/s	Feed rate (Mg/h)	LFC at airflow of 4.79 m^3/s	Feed rate (Mg/h)	LFC at airflow of 5.77 m^3/s
0.93	100.0	0.62	100.0	0.25	100.0
1.31	100.0	1.03	99.9	1.00	94.8
1.32	100.0	1.44	100.0	2.38	99.4
4.93	100.0	3.62	99.1	5.56	99.1
6.61	100.0	4.05	100.0	10.79	100.0
Average	100.00	Average	99.80	Average	98.66

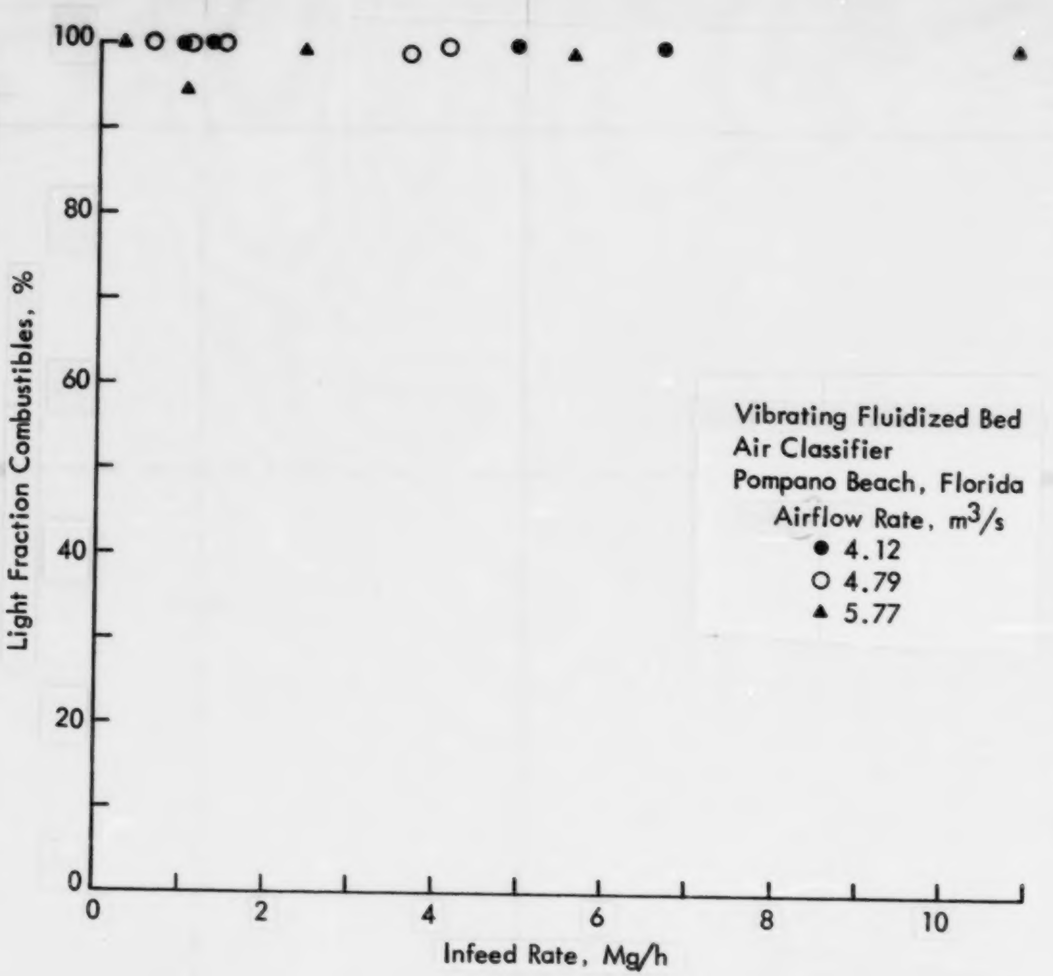

Figure 68. Light fraction combustibles versus infeed rate - Pompano Beach, Florida.

Table 26 shows RDF yield over a range of infeed rates for each of the three airflow rates.

TABLE 26. REFUSE-DERIVED FUEL YIELD USING A VIBRATING FLUIDIZED BED AIR CLASSIFIER - POMPANO BEACH, FLORIDA

Feed rate (Mg/h)	RDF-Y at airflow of 4.12 m^3/s	Feed rate (Mg/h)	RDF-Y at airflow of 4.79 m^3/s	Feed rate (Mg/h)	RDF-Y at airflow of 5.77 m^3/s
0.93	86.08	0.62	92.23	0.25	86.09
1.31	91.22	1.03	87.64	1.00	88.32
1.32	88.90	1.44	90.03	2.38	82.69
4.93	62.30	3.62	78.59	5.56	44.48
6.61	40.92	4.05	54.51	10.79	23.68
Average	73.88	Average	80.60	Average	65.52

RDF yield at the lower three infeed rates was relatively level but decreased dramatically at the two highest infeed rates at each airflow rate (see Figure 69). The average RDF yield was the highest at the middle airflow rate and the lowest at the highest airflow rate. Since LFC was generally high at all airflow rates and infeed rates, the light fraction split was the predominant factor which set the RDF yield. Consequently RDF yield could be expected to decrease substantially at infeed rates above the transition zones shown in Figure 67.

A plot of paper and plastic in the heavies versus infeed rate to airflow rate weight ratio is given in Figure 70. At the highest airflow rate the percentage of paper and plastic in the heavies increases with increasing solid to air weight ratios. At the other two airflow rates, no definite trends were observed. The infeed rate to airflow rate ratios at the rated capacity range of the air classifier (4.5 to 6.8 Mg/h) for the low, middle, and high airflow rates were 0.25 to 0.39, 0.22 to 0.33, and 0.18 to 0.28, respectively. When operating in the rated capacity range and below at either the lowest or middle airflow rates, paper and plastic in the heavies was generally greater than 65%, whereas at the highest airflow rate values ranged from 25 to 75%.

A plot of percentage of ash from lights versus infeed rate to airflow rate weight ratio is given in Figure 71. Ash from burning paper and plastic ranged from 6.7 to 17.3% weight. The level of ash content at all airflow rates showed considerable noncombustibles were carried over with the lights at each infeed rate. The level of ash at all airflow rates was low which indicates the benefit of the trommel screen unit ahead of the air classifier in removing noncombustibles (glass, grit, and metals).

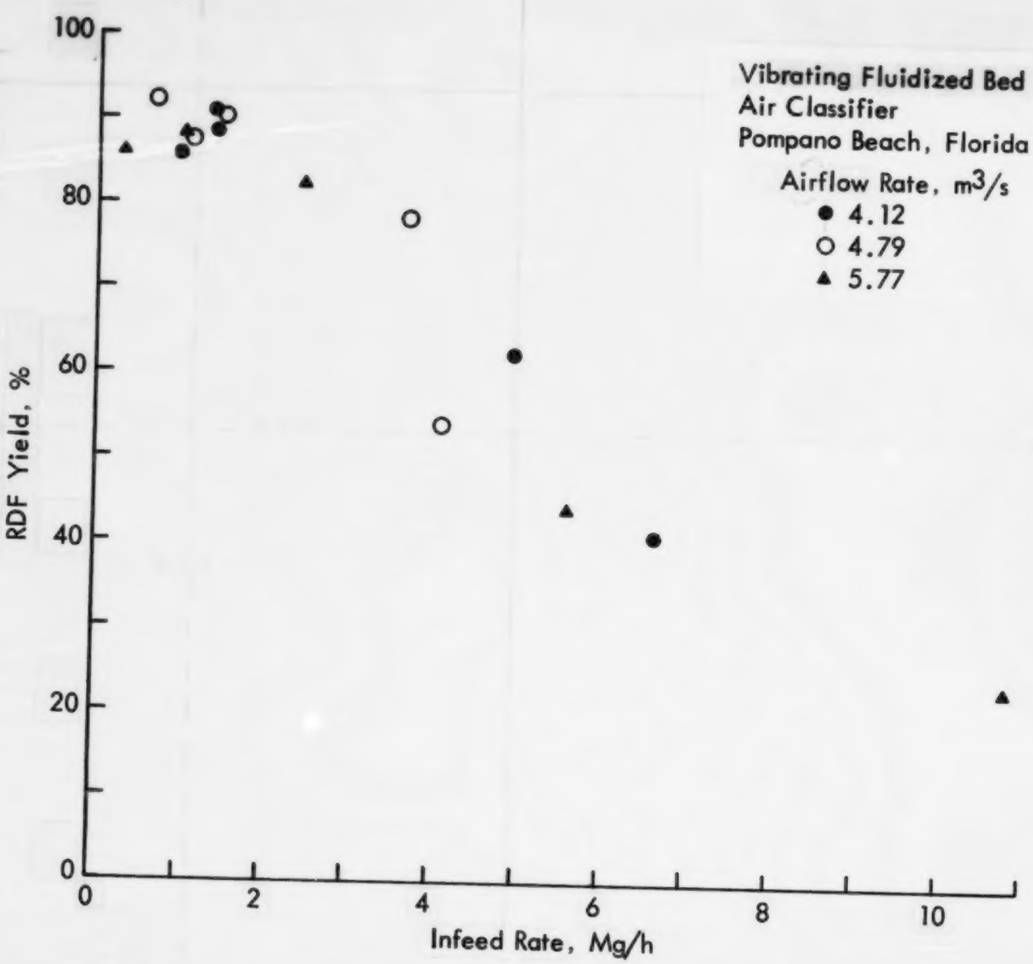

Figure 69. Refuse-derived fuel yield versus infeed rate - Pompano Beach, Florida.

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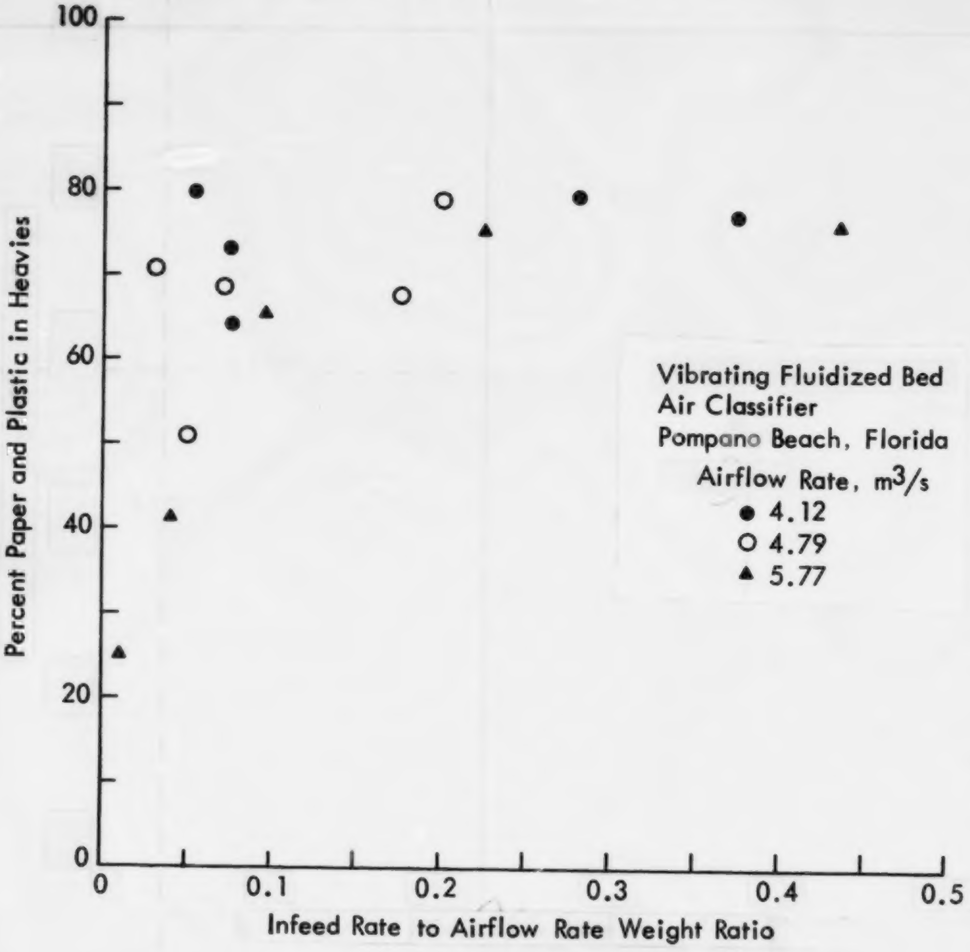

Figure 70. Percentage of paper and plastic in heavies versus solids to air weight ratio - Pompano Beach, Florida.

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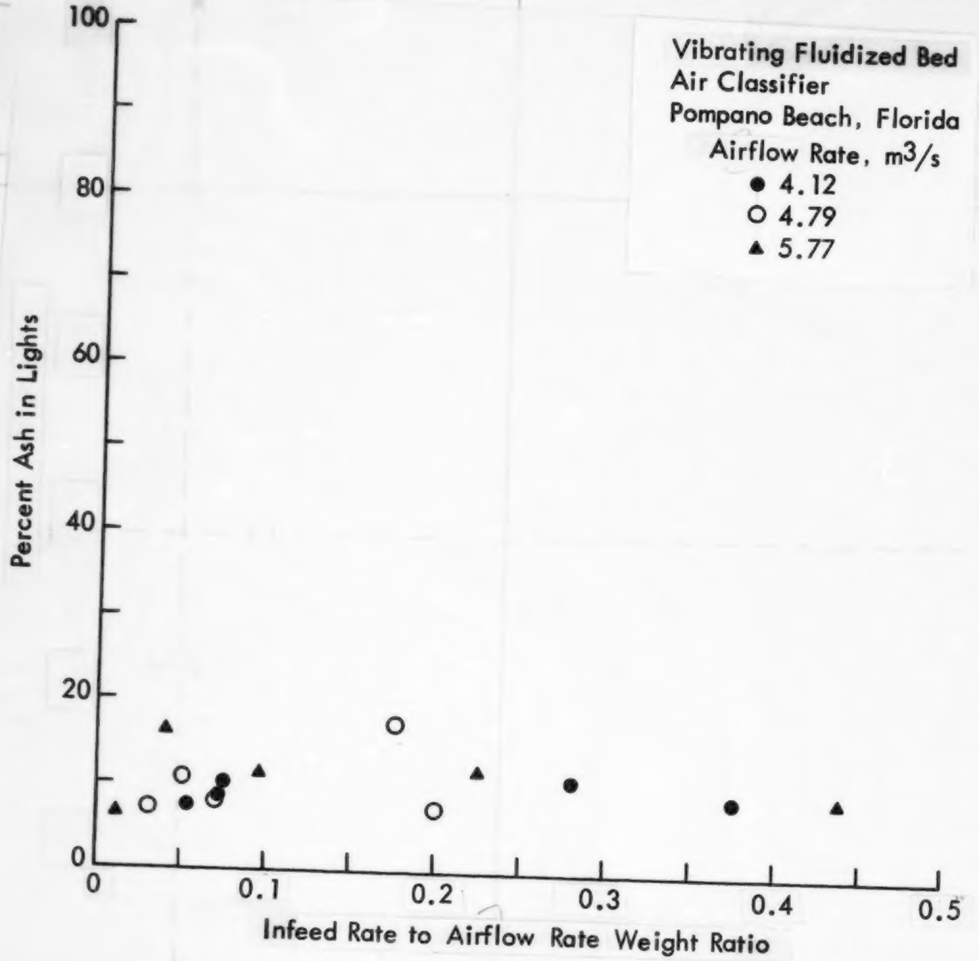

Figure 71. Percentage of ash from lights versus solids to air weight ratio - Pompano Beach, Florida.

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A plot of percentage of lights produced versus infeed rate to airflow rate weight ratio is shown in Figure 72. The highest production of lights to the upper end of the rated capacity range of the air classifier occurred at the highest airflow rate. A drop in lights production at the other two airflow rates was encountered before the lower end of the rated capacity range was reached. The best overall performance of the air classifiers was realized at the highest airflow rate.

The average oven dry heating value for the eight samples analyzed for heating value was 20,077 kJ/kg for the lights and 17,147 kJ/kg for the heavies, a 14.6% difference. Therefore light fraction energy recovery was higher than light fraction material weight recovery. Percentage of total energy contained in the infeed recovered by the air classifier in the light fraction varied between 93.1% and 56.3% and is plotted in Figure 73. The trend is that the higher percentage energy recoveries occurs at the lower infeed flow rates and the higher airflow rates.

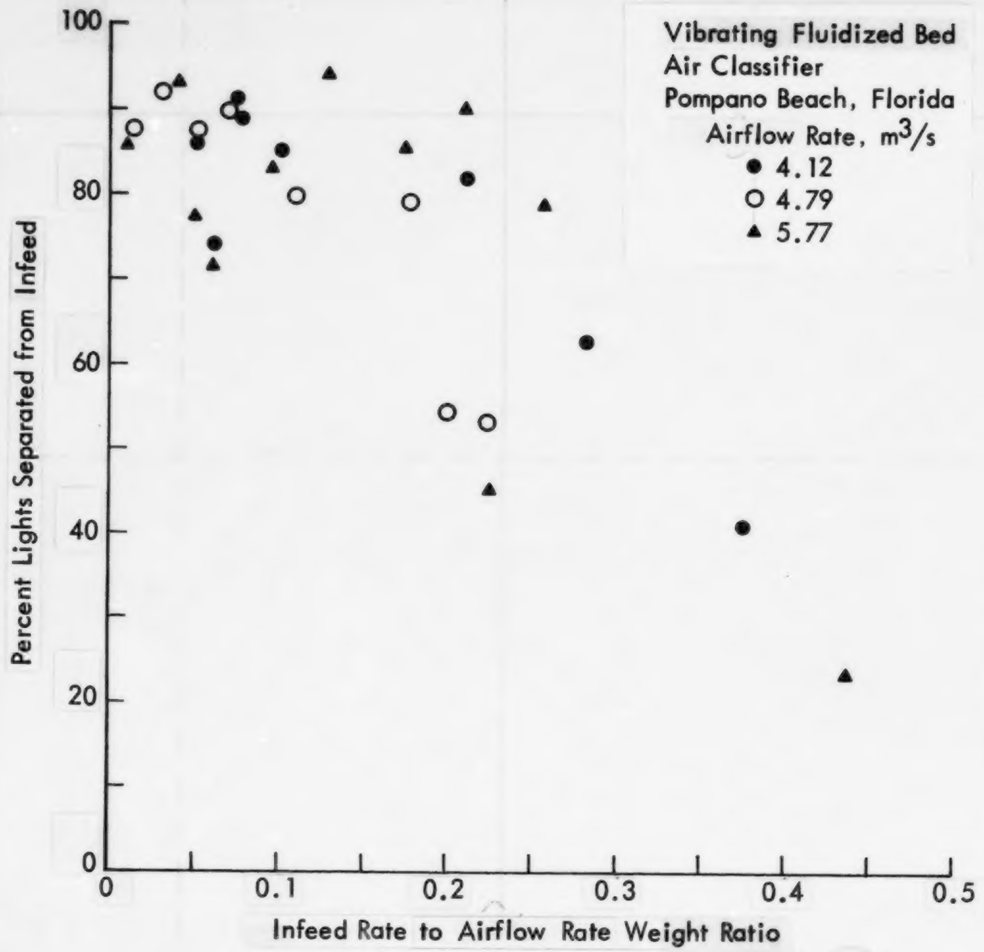

Figure 72. Percentage lights separated from infeed versus solids to air weight ratio - Pompano Beach, Florida.

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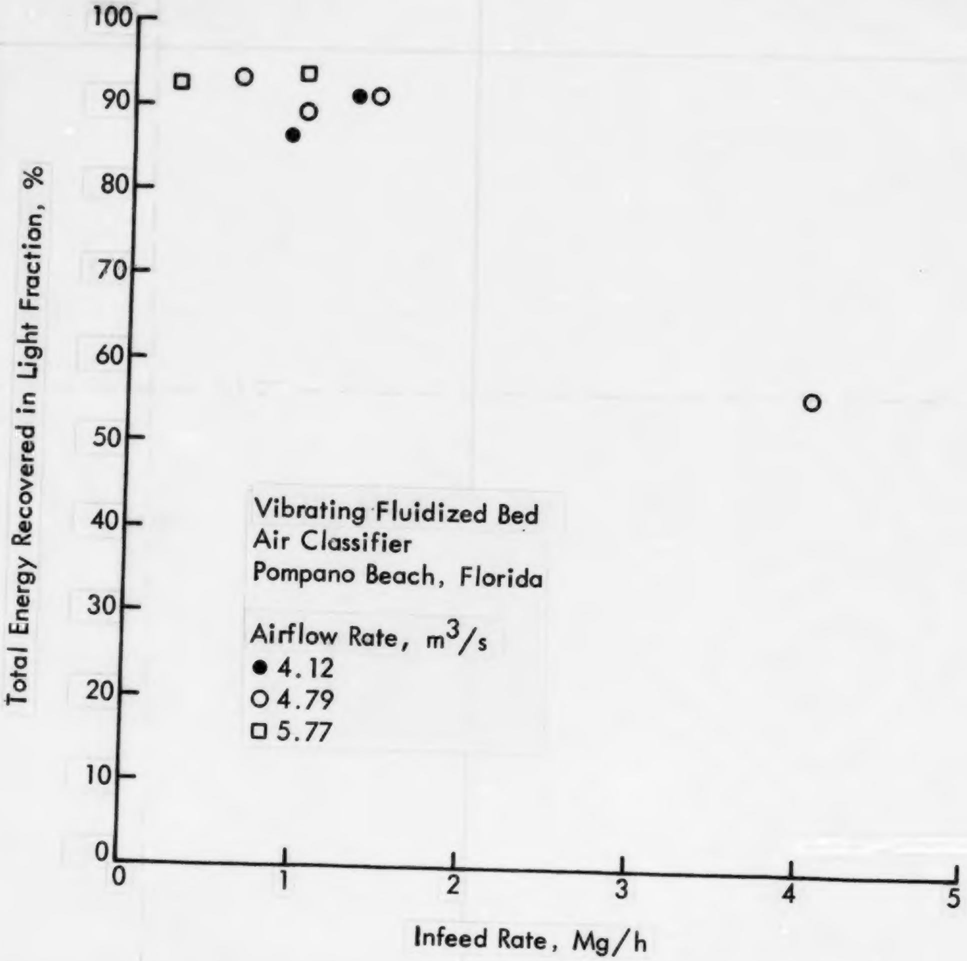

Figure 73. Energy recovery versus infeed rate - Pompano Beach, Florida.

SECTION 5

COMPARISON OF AIR CLASSIFIERS

In this section are presented the results of the performance characterization of the air classifiers tested during the study. In order to allow an objective comparison among the air classifiers, the operating and performance parameters chosen for evaluation were selected so as to eliminate the effects of air classifier geometry and physical size, volumetric airflow, material throughputs, etc. To complete the characterizations, economic data were also collected and utilized as part of the evaluation.

ENVIRONMENTAL COMPARISONS

The design data on the seven air classifiers are as follows.

Air classifier	Highest airflow tested (m^3/s)	Air exhaust control
Tacoma	45.20	100% recirculated air
Baltimore	38.46	Baghouse
Richmond	2.57	Cyclone
Ames	11.13	Baghouse
Los Angeles	4.99	Cyclone
Akron	30.35	Baghouse
Pompano Beach	5.77	Baghouse

Previous tests of baghouses used on air classifier exhaust[10] have shown baghouses to have 99.95% particulate removal efficiency, and, of course, 100% air recirculation should have no emission to atmosphere. Therefore, as the tabulation above shows, particulate emissions to atmosphere for the Tacoma, Baltimore, Ames, Akron, and Pompano Beach air classifiers are not a problem. The Richmond and Los Angeles units are smaller experimental air classifiers where air emissions are controlled by cyclone collectors. Baghouses could easily be added to both these units. Because air is pulled through all seven air classifiers tested, they are under slight negative air pressure and fugitive particulate emissions are not a problem except for minor spillage from conveyors.

OPERATIONS

Once plant personnel have learned how to operate their particular units, operation and maintenance of the air classifiers are not believed by the plant personnel to be a serious problem. According to a previous EPA study,[8] Ames has a record of operating experience on the air classifier. That evaluation showed that as the operators became more skilled, the air classifier performance improved. Therefore, in this study no comparisons are made between air classifiers on the basis of operation and maintenance. The comparisons that are drawn are based on performance under optimum operating conditions.

CRITERIA FOR ENERGY RECOVERY AND PERFORMANCE COMPARISONS

In making comparisons of air classifier performance, it was necessary to select criteria that described all air classifiers. The data collected during this study indicated that air classifiers may be treated generically; i.e., there exist key parameters that may be compared among air classifiers without regard to their geometry or operating principles. Because the field tests were conducted over a wide range of material throughput and airflow rates, less than optimum performance was obtained for those operating conditions which were atypical of normal plant operation. Therefore, it was important to compare the air classifiers at those operating conditions where the best performance occurred and not under less than optimum conditions. Less than optimum conditions can arise from several factors; e.g., plant personnel have not established the optimum airflow setting, or the air classifier manufacturer has failed to recommend an operating set point for optimum air classifier operation.

Light fraction production versus infeed rate for each airflow is constant until a transition zone is reached and the light fraction split changes to lower and more variable values. The only exceptions to this finding was the test data acquired during the high airflow setting at Tacoma, the middle airflow setting at Los Angeles, and all three airflow settings at Ames. Data from all other air classifier tests showed a definite transition zone. Due to processing limitations at Ames, the air classifier could not be tested at capacities exceeding 45 Mg/h; therefore, it is assumed that all test data were collected at operating conditions that were below the transition zones for the Ames air classifier. No transition zone was indicated for the Los Angeles middle airflow setting despite the fact that transition zones were indicated for the low and high airflow settings. The lack of a transition zone for the tests conducted on the Tacoma air classifier operating at the high airflow settings was attributed to the inability of the material handling system to handle material throughput which could choke the air classifier.

The significance of the transition zones is that for any given airflow there is an upper material infeed rate limit for maximum lights production. Because this infeed limit is different for different airflows, it can best be expressed by the air solids (A/S) ratio, which is the ratio of the weight flow rate of air to the weight flow rate of infeed material. In Section 4 the weight flow rate of air was recorded on the plots of the lights recovered versus the infeed rate so that the A/S ratio for any given infeed rate could be easily calculated.

Obviously the light fraction recovery rate is greater for those infeed rates at and below the transition zone. However, determination of the transition zone is subjective, i.e., based on graphical interpretation. On the other hand, the critical A/S ratio, defined and calculated as the point at which the value of the constant light fraction split as a function of the A/S ratio is decreased by 1%, provides precise definition.

The A/S ratio is a fundamental parameter that is widely used in the pneumatic conveying industry, and it may be applied to the evaluation of air classifier performance. The concept of the critical A/S ratio has been developed previously for use in evaluating air classifiers.[11] A primary advantage of the A/S ratio is its nondimensional nature which in the case of the evaluation of air classifiers enables their performance to be characterized independently of material throughput, volumetric airflow rate, and air classifier geometry.

The performance characterization, e.g., percentage of paper and plastic recovered and energy recovered, presented in this section is based upon the performance parameters corresponding to their respective critical A/S ratio. The manner of performance characterization presented herein results in a comparison among air classifiers while they are exhibiting their best performance for the operating conditions used during the field tests. The performance characterization begins with a discussion of energy recovery comparisons and is followed by additional performance comparisons. It should be drawn to the reader's attention that in order to achieve optimum performance, the critical A/S ratio is used in conjunction with the volumetric airflow in order to generate the maximum throughput at which the air classifier should be operated in order to achieve optimum performance.

ENERGY RECOVERY

The purpose of most air classifiers in waste-to-energy processing is to recover energy from shredded MSW by separating materials with high energy content (or heating value) and low ash content from materials with a low energy content and relatively high ash content.

Table 27 presents the average heating values for air classified light and heavy fractions obtained under various airflow settings for each of the seven air classifiers tested. The average heating values were those measured for samples taken when the material throughput was such that the A/S ratio was greater than the critical value. Also shown in Table 27 are the percentages of energy recovered in the light fraction based upon the energy content of the air classifier feedstock. The energy content of the feedstock was calculated from the heating values measured for the light and heavy fractions and the mass fraction split measured during the field testing, as described in Section 3.

TABLE 27. AVERAGE VALUES OF HEATING VALUES AT OPERATING CONDITIONS ≧ CRITICAL AIR SOLIDS RATIOS

Site	Airflow setting	Critical A/S ratio	Heating value Lights (kJ/kg)	Heating value Heavies (kJ/kg)	Percent energy recovered in lights
Tacoma	High	≦ 1.6	15,773	9,624	87.4
	Medium	1.7	14,608	11,907	77.9
	Low	1.7	16,308	11,435	68.2
Baltimore	High	3.5	10,440	5,768	90.8
	Medium	5.5	12,628	4,687	73.1
	Low	7.5	12,791	9,060	85.8
Richmond	High	5.1	13,434	1,513	97.2
	Medium	6.8	13,031	4,942	88.6
	Low	8.5	12,422	9,927	65.2
Ames	High	≦ 2.6	17,100	7,450	93.0
	Medium	≦ 2.5	19,000	9,546	86.0
	Low	≦ 1.5	17,107	11,846	91.1
Los Angeles	High	6.6	18,962	10,762	95.5
	Medium	5.9	17,825	7,362	90.8
	Low	5.6	19,598	10,647	74.8
Akron	High	6.4	14,343	2,273	99.3
	Medium	4.7	13,430	I[a]	99.9
	Low	4.6	15,913	6,397	93.3
Pompano Beach	High	5.6	18,038	12,060	93.3
	Medium	6.3	21,171	18,303	91.4
	Low	5.2	19,978	19,287	88.9

[a] I = insufficient data.

Table 27 shows that from 65 to 99% of the feedstock energy content can be recovered in the light fraction, and that air classifiers operating near their normal set points recover energy in the range of 87 to 99%.

At three sites, Pompano Beach, Ames, and Los Angeles, the recovered light fraction had a relatively high heating value (17,100 to 21,200 kJ/kg), as indicated in Table 27. The Pompano Beach and Ames light fractions exhibited this relatively high heating value because of screening prior to air classification. At Los Angeles no screening was employed prior to air classification, and the reason for the relatively high heating value is unknown.

PERFORMANCE AND ECONOMICS

Table 28 presents the results of all key parameters based upon material characteristics. The definitive parameters are listed under the heading "Percent of Component Retained in Light Fraction" since they have been normalized as a function of the air classifier infeed material properties. All values in Table 28 are averages for each air setting and for A/S ratios exceeding the critical A/S ratio.

Table 29 presents a summary of the operating parameters for each air classifier and the airflow settings used in the field tests.

Since the field tests covered a number of different air classifiers, analysis of the test data allows the establishment of the magnitudes of a number of factors that should be of interest to the resource recovery industry. Such factors include the percentages of ferrous metals, nonferrous metals, retained fines, and paper and plastic in the light fraction. Results of all seven field tests analyzed collectively enabled an overall, or average, value of certain parameters to be calculated, as shown in Table 30. Such average values subsequently can be used for calculation of mass and energy balances on an air classifier system. For example, the mass fraction of nonferrous metals in the light fraction can be computed from the mass fraction of nonferrous metals in the air classifier feed and the percentage of nonferrous metals retained in the light fraction.

Certain other factors involving the calculation of mass balances can also be gleaned from the test data. For example, the data in Table 30 show the probable values for various operating and performance parameters that characterize air classifiers. For design purposes, the data in the table allow an estimation of typical levels of performance. For example, the minimum and maximum values of paper and plastic in the heavy fraction can be seen to be 0.8 and 42%, respectively, although an average value of 3 to 30% appears to be possible with properly tuned air classifiers. Other noteworthy findings include typical ranges of: (a) 2 to 20% and 45 to 65%, respectively, for retained ferrous and retained aluminum in the light fraction; (b) 1 to 11 kWh/Mg in specific energy requirements; (c) 1.2 to 2.0 in recovered energy to retained ash ratios; and (d) $5,800 to $8,200 per Mg/h in system capital costs.

TABLE 28. AVERAGE MATERIAL CHARACTERISTICS FOR ≧ CRITICAL AIR SOLIDS RATIOS

		Heavy fraction			Light fraction						PP	Percent of component retained in light fraction					
Airflow setting	MC (%)[a]	PP[b] (%)[c]	Heating value (kJ/kg)[d]	MC (%)[a]	Fe (%)[c]	NonFe (%)[c]	Ash (%)[c]	Fines (%)[c]	Quality (%)[c]	Heating value (kJ/kg)[d]	combus. yield (%)[c]	Ash[c]	Fines[c]	Fe[c]	NonFe[c]	Recov. PP[c]	Recov. Energy[d]
Tacoma																	
High	18.3	29.4	9,625	25.1	3.3	1.1	32.7	19.6	58.8	15,773	44.9	62.7	94.6	26.0	34.7	86.7	87.4
Medium	20.9	38.6	11,907	26.3	1.0	1.5	28.6	16.3	63.8	14,608	47.5	61.9	88.5	9.4	53.5	84.4	77.9
Low	28.7	42.8	11,435	30.7	1.8	1.3	32.2	17.5	66.7	16,308	41.5	48.6	83.1	14.2	43.4	69.5	68.2
Baltimore																	
High	12.8	7.3	5,768	32.7	0.2	0.3	23.8	29.1	56.4	10,440	46.0	66.0	95.8	2.8	44.0	98.5	90.8
Medium	17.7	5.0	4,687	27.6	0.0	0.0	18.8	16.0	70.0	12,628	55.0	58.0	98.5	0.0	0.0	95.0	73.1
Low	16.0	16.5	9,060	32.0	0.0	0.2	20.7	19.9	63.0	12,791	48.4	57.0	92.0	0.0	39.7	92.1	85.8
Richmond																	
High	13.0	6.3	1,513	20.8	3.0	1.2	21.2	12.4	63.8	13,434	52.8	56.0	97.0	26.4	55.4	98.3	97.2
Medium	13.6	12.4	4,942	20.4	0.3	0.7	19.1	20.1	59.7	13,031	47.0	45.0	93.2	5.8	43.2	93.8	88.6
Low	17.1	28.0	9,927	15.3	0.0	0.2	16.0	16.1	76.2	12,422	45.1	29.3	68.4	0.0	7.2	79.1	65.2
Ames																	
High	8.0	9.1	7,450	15.0	I[e]	I	11.1	7.3	69.3	17,100	58.5	46.2	97.2	I	I	97.8	93.0
Medium	10.0	23.7	9,546	10.9	I	I	10.9	4.0	79.6	19,000	70.4	70.4	87.4	I	I	98.2	86.0
Low	23.7	11.4	11,846	19.2	I	I	8.4	5.3	84.0	17,107	72.4	45.3	95.7	I	I	97.7	91.1
Los Angeles																	
High	14.2	2.9	10,762	19.8	0.1	0.7	34.3	35.4	22.9	18,962	20.2	85.2	98.9	2.5	66.4	98.2	95.5
Medium	9.9	2.5	7,362	8.6	0.2	0.8	26.8	23.6	36.9	17,825	31.4	74.0	99.2	8.5	71.3	99.0	90.8
Low	11.3	16.2	10,647	6.8	0.1	0.8	23.1	37.5	44.0	19,598	28.5	42.2	82.2	0.9	46.2	82.8	74.8
Akron																	
High	13.3	0.8	2,273	15.6	0.6	0.6	21.4	25.0	55.2	14,343	53.6	88.1	100.0	19.8	96.7	99.9	99.3
Medium	0[f]	2.7	I	16.5	0.6	0.6	25.2	29.0	59.7	13,430	52.0	69.7	99.1	8.1	58.8	99.0	99.9
Low	9.8	22.8	6,397	18.7	1.0	0.5	26.8	28.6	51.4	15,913	45.3	76.3	99.8	25.5	28.8	98.0	93.3
Pompano Beach																	
High	11.9	43.9	12,060	13.8	0.4	0.9	11.5	8.7	80.1	18,038	69.7	64.6	91.2	15.8	34.3	92.3	93.3
Medium	13.8	63.4	18,303	8.4	0.0	0.7	8.9	5.8	87.8	21,171	79.6	80.2	95.1	0.0	51.1	93.2	91.4
Low	14.2	71.6	19,287	10.9	0.2	1.4	8.9	7.2	84.1	19,978	74.9	81.2	93.9	32.1	64.4	90.5	88.9

[a] MC = average air dry moisture content
[b] PP = paper and plastic
[c] air dry moisture basis
[d] oven dry moisture basis
[e] I = insufficient data
[f] one sample only

TABLE 29. SUMMARY OF OPERATING PARAMETERS OF AIR CLASSIFIERS TESTED

Site	Airflow setting	Critical specific energy kWh/Mg	Critical specific energy (kWh/ton)	Critical column loading Mg/h/m²	Critical column loading (ton/h/ft²)	Critical A/S ratio	Average column velocity m/s	Average column velocity (fpm)	Heavies throat m/s	Heavies throat (fpm)
Tacoma	High	≦ 1.1	(≦ 1.0)	≧ 46.0	(≧ 4.7)	≦ 1.6	17.29	(3,404)	NA[a]	
	Medium	1.0	(0.9)	37.2	(3.8)	1.7	15.26	(3,005)		
	Low	0.9	(0.8)	36.2	(3.7)	1.7	14.36	(2,826)		
Baltimore	High	5.9	(5.4)	9.8	(1.0)	3.5	8.18	(1,610)	NA	
	Medium	9.0	(8.2)	5.9	(0.6)	5.5	7.31	(1,440)		
	Low	13.2	(12.0)	3.9	(0.4)	7.5	6.35	(1,250)		
Richmond	High	5.1	(4.6)	8.8	(0.9)	5.1	6.38	(1,257)		
	Medium	9.2	(8.4)	4.9	(0.5)	6.8	4.48	(881)		
	Low	9.4	(8.5)	2.0	(0.2)	8.5	3.43	(676)		
Ames	High	≦ 7.6	(6.9)	≧ 18.6	(≧ 1.9)	≦ 2.6	11.42	(2,248)	NA	
	Medium	≦ 7.6	(6.9)	≧ 17.6	(≧ 1.8)	≦ 2.5	10.74	(2,115)		
	Low	≦ 4.6	(4.2)	≧ 27.4	(≧ 2.8)	≦ 1.5	11.52	(2,268)		
Los Angeles	High	8.2	(7.5)	8.8	(0.9)	6.6	11.29	(2,223)	NA	
	Medium	9.5	(8.6)	7.8	(0.8)	5.9	8.75	(1,722)		
	Low	11.4	(10.4)	4.9	(0.5)	5.6	6.19	(1,218)		
Akron	High	14.1	(12.9)	16.7	(1.7)	6.4	26.21	(5,160)	18.41	(3,624)
	Medium	10.5	(9.6)	21.6	(2.2)	4.7	24.70	(4,862)	18.46	(3,634)
	Low	11.4	(10.4)	20.6	(2.1)	4.6	22.36	(4,401)	16.05	(3,159)
Pompano Beach	High	11.2	(10.2)	11.8	(1.2)	5.6	15.51	(3,055)	3.33	(657)
	Medium	15.0	(13.6)	8.8	0.9	6.3	12.89	(2,538)	2.20	(433)
	Low	14.6	(13.3)	8.8	(0.9)	5.2	11.08	(2,182)	1.97	(388)

[a] NA = Not applicable.

TABLE 30. SUMMARY OF OPERATING AND PERFORMANCE CHARACTERIZATION OF AIR CLASSIFIER SYSTEMS TESTED

Item	High	Low	Typical range[a]
Critical air/solids ratio	8.5	≦ 1.5	2 - 7
Paper-plastic in heavy fraction (%)	42.8	0.8	5 - 30
Light fraction composition (%)			
Ferrous metals	3.3	0.0	0.1 - 1.0
Nonferrous metals	1.5	0.0	0.2 - 1.0
Fines	37.5	4.0	15 - 30
Paper and plastic	87.8	22.9	55 - 80
Ash	34.3	5.8	10 - 35
Percent of component retained in light fraction			
Ferrous metals	32.1	0.0	2 - 20
Nonferrous metals	96.7	0.0	45 - 65
Fines	100.0	68.4	80 - 99
Paper and plastic	99.9	69.5	85 - 99
Ash	85.2	29.3	45 - 85
Recovered energy (%)	99.9	65.2	73 - 99
Specific energy (kWh/Mg)	15.0	0.9	1 - 11
Column loading (Mg/h/m²)	≧ 46.0	2.0	5 - 40
Recovered paper-plastic/retained ash	0.9	1.1	1.0
Recovered energy/retained ash	2.3	1.1	1.2 - 2.0
1980 $/Mg/h	≦ 14,000	4,300	5,800 - 8,200

[a] Typical range to be expected.

In order to develop a similar criterion for evaluating an air classifier in terms of its ability to recover a "high quality fuel," the ratio of recovered energy to retained ash was evaluated. Both recovered energy and retained ash in the light fraction are normalized on an infeed basis, thus eliminating the effects of variation of refuse composition on air classifier performance. Large values of the ratio of recovered energy to retained ash (RE/RA) imply that an air classifier is recovering in the light fraction a significant percentage of the energy available in the infeed material while removing a significant percentage of the ash.

Tables 31 and 32 present the data used for the calculation of the average values of RE/RA. Due to the fact that for each air classifier only selected samples of heavy and light fractions were analyzed for heating value, average values of RE/RA were calculated by dividing the average value of RE by the average value of RA for each airflow setting. Where possible, only heating value and ash data for the same samples were used in the calculations (as shown for all sites except Ames). Due to the back-calculating needed for determining the properties of the Ames light fraction samples and the attendant inconsistencies of the data, for Ames as much of the ash data as possible was used for the calculations of RE/RA (as shown on Table 32). A summary of the average values of the RE/RA ratios for each air classifier and airflow setting is shown in Table 33. Data from the table show a range of values for each air classifier depending upon the airflow setting and variations among air classifiers.

If the maximum values of RE/RA for each air classifier are chosen as the criterion (or premise) for determining the optimum operating point for recovery of a high quality RDF, then other performance parameters can also be chosen for comparison based upon the airflow setting resulting in the maximum value of RE/RA for each air classifier. Some key parameters for each air classifier at its optimum airflow setting (shown in the second column) are shown in Table 32.

Table 34 lists the 1980 air classifier capital costs. Costs were determined by escalating reported capital costs (10%/year) to 1980 levels and dividing them by the maximum throughput for each air classifier at its optimum airflow setting. Thus, cost for each air classifier is reported on a constant dollar basis, even though the various air classifiers were purchased and installed in different years.

A unit cost ($/Mg/h) for purposes of comparison can also be developed based upon the cost of the air classifier system and the throughput corresponding to the critical air/solids ratio for the airflow setting resulting in the maximum value of recovered energy/retained ash. The unit costs for the seven tested air classifiers are in the range of $4,300 to $14,000 per Mg/h, as shown in Table 35.

TABLE 31. VALUES OF RATIO OF PERCENT ENERGY RECOVERED$_{LTS}$ TO PERCENT ASH RETAINED$_{LTS}$ FOR ≧ CRITICAL A/S RATIO

Site	Airflow setting	Sample No.	% energy recovered in lights	% ash retained in lights	Avg. % energy recovered$_{LTS}$[a] / Avg. % ash retained$_{LTS}$
Tacoma	High	7	89.8	67.8	1.29
		8	84.9	67.5	
	Medium	11	80.5	69.4	1.26
		12	77.9	57.8	
		13	75.3	58.5	
	Low	1	68.8	48.4	1.47
		3	67.6	44.5	
Baltimore	High	12	90.6	53.0	1.83
		14	90.9	46.1	
	Medium	30	73.1	57.1	1.28
	Low	2	83.8	49.6	1.50
		3	87.7	64.5	
Richmond	High	1	96.7	45.2	2.25
		2	97.6	41.1	
	Medium	9	84.7	40.3	2.07
		11	87.7	46.5	
		14	93.3	41.6	
	Low	16	78.5	28.8	2.25
		17	51.8	29.2	
Los Angeles	High	12	96.2	91.6	1.12
		18	94.7	78.3	
	Medium	20	94.1	74.9	1.38
		22	87.5	57.0	
	Low	5	73.0	42.3	1.86
		6	76.6	38.0	
Akron	High	15	98.6	92.5	1.13
		19	100.0	83.7	
	Medium	7	99.9	85.8	1.16
	Low	9	88.9	57.9	1.33
		12	97.7	82.1	
Pompano Beach	High	5	93.6	83.2	1.51
		6	92.9	40.7	
	Medium	22	93.1	84.1	1.14
		23	89.4	76.0	
		25	91.6	80.5	
	Low	14	86.5	78.1	1.07
		18	91.3	87.6	

[a] Average percent energy recovered in lights/average percent ash retained in lights.

TABLE 32. VALUES OF THE RATIO OF ENERGY RECOVERED TO RETAINED ASH FOR ≧ CRITICAL A/S RATIO FOR AMES, IOWA

Airflow setting	Sample No.	% energy recovered in lights	% ash retained in lights	$\frac{\text{Avg. \% energy recovered}_{LTS}}{\text{Avg. \% ash retained}_{LTS}}$[a]
High	1	--	73.4	
	2	92.7	50.7	
	3	93.2	19.3	
	4	--	41.5	
	Avg.	93.0	46.2	2.01
Medium	6	91.0	I[b]	
	7	--	93.7	
	9	81.0	I[b]	
	11	--	47.1	
	Avg.	86.0	70.4	1.22
Low	13	92.4	71.3	
	15	94.9	I[b]	
	17	95.7	36.8	
	18	--	59.5	
	19	81.4	13.7	
	Avg.	91.1	45.3	2.01

---

[a] Average percent energy recovered in lights/average percent ash retained in lights.

[b] I = insufficient data due to negative values calculated for light fraction ash content.

TABLE 33. SUMMARY OF THE RATIO OF AVERAGE RECOVERED ENERGY TO AVERAGE RETAINED ASH FOR EACH AIR CLASSIFIER AND AIR SETTING

Air classifier	Airflow setting	$\frac{\text{Avg. recovered energy}}{\text{Avg. retained ash}}$	Critical A/S ratio
Tacoma	High	1.3	≦ 1.6
	Medium	1.3	1.7
	Low	1.5	1.7
Baltimore	High	1.8	3.5
	Medium	1.3	5.5
	Low	1.5	7.5
Richmond	High	2.3	5.1
	Medium	2.1	6.8
	Low	2.3	8.5
Ames	High	2.0	≦ 2.6
	Medium	I[a]	≦ 2.5
	Low	2.0	≦ 1.5
Los Angeles	High	1.1	6.6
	Medium	1.4	5.9
	Low	1.9	5.6
Akron	High	1.1	6.4
	Medium	1.2	4.7
	Low	1.3	4.6
Pompano Beach	High	1.5	5.6
	Medium	1.1	6.3
	Low	1.1	5.2

[a] I = insufficient data

TABLE 34. AIR CLASSIFIER PERFORMANCE PARAMETERS FOR REFUSE-DERIVED FUEL RECOVERY

Air classifier	Airflow setting for max. RE/RA[a]	E_o (kWh/Mg)	Column loading (Mg/h/m^2)	Avg. recov. energy / Avg. retained ash
Tacoma	Low	0.9	36.2	1.5
Baltimore	High	5.9	9.8	1.8
Richmond	High	5.1	8.8	2.3
Ames	High	≦ 7.6	≧ 18.6	2.0
Los Angeles	Low	11.4	4.9	1.9
Akron	Low	11.4	20.6	1.3
Pompano Beach	High	11.2	11.8	1.5

[a] Max. = Maximum measured during field tests.
RE = Average recovered energy.
RA = Average retained ash.

TABLE 35. AIR CLASSIFIER COST SUMMARY[a]

Air classifier	Installed capital cost ($)	Year installed	Years to 1980	Escalation factor[b] to 1980	1980 Installed capital cost ($)	Critical infeed rate Mg/h[c]	1980 $/Mg/h[d,e]
Tacoma	452,500	1978	2	1.21	548,000	95	5,800
Baltimore	310,000	1976	4	1.46	453,000	36	12,600
Richmond	9,750	1976	4	1.46	14,200	3.3	4,300
Ames	182,854	1975	5	1.61	294,000	≧ 21	≦ 14,000
Los Angeles	12,250[f]	1977[c]	3	1.33	16,300	2.0	8,200
Akron	125,000	1977	3	1.33	166,000	25	6,600
Pompano Beach	18,756[e]	1976	4	1.46	27,400	4.4	6,200

[a] The system costs in general represent cost of materials and installation. However, for some of the air classifiers, engineering design costs were almost certainly part of the total system cost, although this conclusion can not be documented.

[b] Construction year cost escalated at 10% per year to establish 1980 cost.

[c] Calculated maximum feed rate corresponding to the critical air/solids ratio for the airflow setting resulting in the maximum value of recovered energy/retained ash.

[d] In light of the pecularities of the manner of cost accounting as described in footnote a, the $/Mg/h values presented should be viewed with caution, bearing in mind that there are a myriad of factors that may or may not be accounted for in the total system costs.

[e] Rounded costs.

[f] These entries are estimated.

GR459H(2) p. 2

Using the parameters listed in Tables 34 and 35 and the additional criteria of system complexity and environmental content, a comprehensive assessment can be made of the various air classifiers under their respective optimum air setting for RDF recovery. Such a summary of operating and performance parameters for each air classifier is shown in Table 36. The table shows the judging criteria and key parameters used as a method of measure. The first three parameters (specific energy, column loading, and RE/RA) were determined from field measurements, while the latter two (system complexity and environmental control) are of a qualitative nature. The judgment of system complexity was based upon visual observation of the total air classifier systems, including number of conveyors, blowers, cyclones, and mechanical equipment required, the engineering complexity, structural complexity, and an engineering judgment of the degree and type of control necessary to maintain the air classifier in operating order. The last parameter, environmental control, was included because cyclones generally do not exhibit as high a collection efficiency as baghouses or as complete control as 100% recycled air systems. It should be noted that adding baghouses to the Richmond and Los Angeles air classifier systems would have increased the cost of each system.

No rankings have been assigned to the various air classifiers since each user or designer must decide what factors are most important in the specific installation. Trade-offs will always exist. For example, the Tacoma air classifier requires the least specific energy and has the highest column loading, but the RDF quality is poorer and the air classifier system is more complex than the others tested.

The field test data also enable a comparison of the design throughput versus the throughput where choking occurred, as shown in Table 37. The critical infeed rate resulting in the maximum value of the ratio, RE/RA, was always found to be less than the design throughput, except for the Tacoma air classifier. Obviously, the term "design throughput" does not have a precise definition at the present state of air classifier development. If the design throughput is defined as the flow rate that the air classifier can physically accommodate, then all the air classifiers tested were capable of being operated at the design value. The one exception was Ames where, due to plant limitations other than the air classifier itself, it was impossible to test at the air classifier design throughput. Consequently, all the Ames tests were conducted at less than the design value. Except for the Tacoma air classifier, the highest RDF quality (defined by the maximum RE/RA ratio) was achieved at infeed rates that are less than the design throughput.

The use of the RE/RA ratio represents only one basis for evaluating the performance of classifiers. However, for characterizing the performance of a unit process whose goal is the recovery of a high quality RDF, the choice of the ratio RE/RA is a practical one with physical significance. Depending upon the processing objective, other bases of evaluation can be chosen. For example, if fiber recovery is to be the objective of air classification, the starting basis might be the use of the ratio of recovered paper and plastic to retained fines. The subsequent determination of the performance parameters would then follow similarly to that previously described for the RE/RA case where the ratio RE/RA was used.

TABLE 36. OPERATING AND PERFORMANCE FOR REFUSE-DERIVED FUEL RECOVERY OF THE SEVEN AIR CLASSIFIERS TESTED

Category →	Energy requirement	Unit size	RDF quality	System complexity[a]	Cost[b]	Environmental control
Key parameter →	Specific energy (kWh/Mg)	Column loading ($Mg/m^2/h$)	$\frac{\text{Avg. recovered energy}}{\text{Avg. retained ash}}$	Design simplicity rating	1980 cost basis ($\$/Mg/h_{crit}$)	Air emission control
Air classifier						
Tacoma	0.9	36.2	1.5	6	5,800	recycled air[c]
Baltimore	5.9	9.8	1.8	3	12,600	baghouse
Richmond	5.1	8.8	2.3	1	4,300	cyclone
Ames	7.6	≥ 18.6	2.0	4	≤ 14,000	baghouse
Los Angeles	11.4	4.9	1.9	2	8,200	cyclone
Akron	11.4	20.6	1.3	6	6,600	baghouse
Pompano Beach	11.2	11.8	1.5	5	6,200	baghouse

[a] Ratings: 1 = simplest.
6 = most complex.

[b] Estimated cost (equipment and engineering) for air classifier system.
Mg/h_{crit} = megagram per hour feed rate corresponding to the critical A/S ratio, for the airflow setting resulting in the maximum value of recovered energy/retained ash (RE/RA).

[c] 100% recycled air.

TABLE 37. COMPARISON OF INFEED RATES

Air classifier	Design infeed rate (Mg/h)	Critical infeed rate for max. RE/RA[a] (Mg/h_{crit})
Tacoma	73	95
Baltimore	64	36
Richmond	4.0	3.3
Ames	45	≧ 21
Los Angeles	3.6	2.0
Akron	64	25
Pompano Beach	5.7	4.4

[a] Max. = Maximum measured during field tests.
RE = Average recovered energy.
RA = Average retained ash.

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APPENDIX A

FIELD TEST FORMS

Form A-1

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT ____________________

DATE ____________________

SAMPLING LOCATION ____________________

INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE A) ____________________

INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE B) ____________________

STACK I.D., (DISTANCE A - DISTANCE B) ____________________

NEAREST UPSTREAM DISTURBANCE ____________________

NEAREST DOWNSTREAM DISTURBANCE ____________________

CALCULATOR ____________________

SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)

EPA (Dur) 232
4/72

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TOP OF IMAGE AREA
DROPPED HEAD; BEGIN SECTIONS HERE
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3/8"
BOTTOM OF IMAGE AREA OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
EPA Form 2350-6 (4-80)
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TYPING GUIDE SHEET

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Form A-2

PRELIMINARY VELOCITY TRAVERSE

PLANT ____________________
DATE ____________________
LOCATION ____________________
STACK I.D. ____________________
BAROMETRIC PRESSURE, in. Hg ____________________
STACK GAUGE PRESSURE, in. H_2O ____________________
OPERATORS ____________________

SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

EPA (Dur) 233
4/72

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Form A-3

DAILY FIELD LOG FOR WIND, TEMPERATURE, RELATIVE HUMIDITY

DATE________________________

RECORDED BY__________________

READINGS:

APPROXIMATE TIME	TIME	WIND		TEMPERATURE	RELATIVE HUMIDITY	CLOUD COVER
		DIRECTION	VELOCITY			
Arrival						
Midmorning						
Noon						
Midafternoon						
Leaving						

COMMENTS:

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Form A-4

ENERGY FIELD DATA

UNIT	VOLTAGE	CURRENT	PHASE ANGLE	WATTS

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EPA Form 2330-4 (4-80)

PAGE NUMBER

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Form A-5

CONVEYING MECHANISMS DESCRIPTION

NO.	MECHANISM	SPEED	INCLINATION	CROSS SECTION SKETCH	BELT MATERIAL	NOTES

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Form A-6

SAMPLE HANDLING LOG

1/site

G

MRI PROJECT NO. 4596-G

TEST SITE______________________
RECORDED BY____________________

SAMPLE NO.[a/]	DESCRIPTION	DATE	TIME	WAYBILL NO.	SHIPPING COMPANY

[a/] Sample No. = Project No.-Item No.-Run No.

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Form A-7

MATERIAL FEED RATES

DATE____________________
SITE____________________
RECORDED BY________________

SAMPLE					
NUMBER	WEIGHT (lb)	LENGTH (ft)	TARE (lb)	BELT SPEED (ft/min)	FEED RATE[a] (tons/hr)

[a] Feed rate = (weight - tare) ÷ length x belt speed x k.

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TYPING GUIDE SHEET

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Form A-8

PRESSURE DROP FIELD DATA

DATE____________________
SITE____________________
RECORDED BY_______________

SKETCH SYSTEM:

PRESSURE TAP	PRESSURE cm H_2O
1	
2	
3	
4	

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APPENDIX B

FIELD TEST DATA FOR HORIZONTAL AIR CLASSIFIER--TACOMA, WASHINGTON

TABLE B-1. SUMMARY OF OPERATIONAL DATA--TACOMA, WASHINGTON

Run No.	Input feed rate (Mg/h)	Lights feed rate (Mg/h)	Split percent lights	Air setting (m^3/min)	Ash percent in lights	Ash percent in heavies	Paper + plastic percent in lights	Lights[a] percent moisture content	Paper + plastic percent in heavies	Higher heating Value,[b] kJ/kg Lights	Higher heating Value,[b] kJ/kg Heavies
1	87.12	54.75	62.85	2249.30	36.7	61.5	92.77	31.8	39.0	16,091	11,444
2	33.34	21.61	64.81	2249.30	29.8	52.6	75.32	24.0	49.18		
3	54.51	33.02	60.58	2249.30	27.6	49.8	88.80	34.7	46.29	16,524	11,425
4	43.42	27.22	62.70	2249.30	34.8	61.7	67.27	32.3	34.03		
5	127.15	66.86	52.58	2249.30	35.3	44.4	89.82	33.3	48.67		
6	58.94	46.09	78.20	2712.15	33.8	63.3	73.39	24.5	29.77		
7	75.07	63.36	84.41	2712.15	32.3	71.4	79.66	24.6	21.07	16,426	8,657
8	79.60	64.12	80.54	2712.15	29.2	55.6	84.16	25.8	26.16	15,119	10,590
9	25.55	16.87	66.04	2712.15	29.0	60.3	86.42	25.4	24.72		
10	116.29	95.89	82.46	2712.15	39.2	72.1	83.89	28.2	25.68		
11	82.22	64.46	78.40	2336.46	30.5	52.6	81.16	27.4	45.36	15,796	12,281
12	12.50	9.70	77.54	2336.46	25.9	60.9	87.51	24.0	30.87	12,274	11,197
13	50.46	36.55	72.45	2336.46	29.3	49.3	86.54	27.4	36.99	15,754	12,242
14	120.17	62.26	51.81	2336.46	31.3	51.4	82.56	29.4	38.18	15,147	11,802

[a] From initial to air-dried condition.
[b] Oven dried basis.

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TYPING GUIDE SHEET

TABLE B-2. FEED RATES--TACOMA

			Lights						Heavies						Input
Date 1979	Airflow setting, m^3/min	Run No.	Sample weight (kg)	Tare weight (kg)	Balance weight (kg)	Sample length (m)	Belt speed (m/min)	Feed rate (Mg/h)	Sample weight (kg)	Tare weight (kg)	Balance weight (kg)	Sample length (m)	Belt speed (m/min)	Feed rate (Mg/h)	Feed rate (Mg/h)
5-7	2249.30	1	26.53	0.13	26.40	1.07	36.88	54.75	9.39	0.04	9.35	1.07	61.57	32.36	87.12
5-7	2249.30	2	27.01	0.23	26.79	2.74	36.88	21.61	20.46	0.13	20.33	6.40	61.57	11.73	33.34
5-7	2249.30	3	54.91	0.33	54.58	3.66	36.88	33.02	21.42	0.15	21.27	3.66	61.57	21.49	54.51
5-8	2249.30	4	15.10	0.10	15.00	1.22	36.88	27.22	15.38	0.15	15.23	3.47	61.57	16.19	43.42
5-8	2249.30	5	37.03	0.20	36.83	1.22	36.88	66.86	32.49	0.15	32.34	1.98	61.57	60.29	127.15
5-8	2712.15	6	25.54	0.15	25.39	1.22	36.88	46.09	8.00	0.05	7.95	2.29	61.57	12.85	58.94
5-8	2712.15	7	26.39	0.20	26.19	0.91	36.88	63.36	6.81	0.05	6.76	2.13	61.57	11.71	75.07
5-8	2712.15	8	26.70	0.20	26.50	0.91	36.88	64.12	8.99	0.05	8.94	2.13	61.57	15.49	79.60
5-9	2712.15	9	9.39	0.10	9.29	1.22	36.88	16.87	5.42	0.05	5.37	2.29	61.57	8.68	25.55
5-9	2712.15	10	53.12	0.30	52.82	1.22	36.88	95.89	11.83	0.05	11.78	2.13	61.57	20.40	116.29
5-9	2336.46	11	26.84	0.20	26.64	0.91	36.88	64.46	7.38	0.05	7.33	1.52	61.57	17.76	82.22
5-9	2336.46	12	16.17	0.15	16.02	3.66	36.88	9.70	1.79	0.05	1.74	2.29	61.57	2.81	12.50
5-9	2336.46	13	15.21	0.10	15.11	0.91	36.88	36.55	8.65	0.05	8.60	2.29	61.57	13.90	50.46
5-9	2336.46	14	25.93	0.20	25.73	0.91	36.88	62.26	19.21	0.10	19.11	1.22	61.57	57.91	120.17

Sample calculation:

$$\text{Balance Wt} \times \frac{\text{belt speed}}{\text{sample length}} \times k_1 \times k_2 = \text{Feed rate}$$

For lights Run 1:

$$26.40\text{kg} \times \frac{36.88\text{ m/min}}{1.07\text{m}} \times 60\ \frac{\text{min}}{\text{h}} \times \frac{1\text{ Mg}}{1000\text{ kg}} = 54.75\text{ Mg/h}$$

TABLE B-3. AIRFLOW, LOWEST--TACOMA, WASHINGTON

Date 5/10/79 Baro. press. 29.92 in Hg	Point	Airflows, pressure drops											
		Traverse location (cm)	Total pressure		Pressure drop (in H_2O)	Velocity pressure inlet		Air density αA (lb/ft^3)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m^2)	Airflow rate (m^3/min)	Airflow rate (Mg/h)
			Inlet Δ_h (in H_2O)	Outlet Δ_h (in H_2O)		Δh_i (in H_2O)	$\sqrt{\Delta h_i}$						
Fan 1	1	5.08	-0.37	1.45		1.80	1.34						
Sheave ∅ = (7 in.)	2	15.24	-0.60	1.20		1.70	1.30						
T_D = 27.8°C (82°F)	3	30.48	-1.00	0.95		1.20	1.10						
T_W = 16.7°C (62°F)	4	45.72	-1.30	0.88		1.05	1.02						
	5	60.96	-1.10	0.20		1.40	1.18						
Average			-0.87	0.94	1.81	1.43	1.19	0.0737	4,807.53	1,465.35	0.657	962.77	68.25
Fan 2	1	5.08	-4.50	6.60		0.25	0.50						
Sheave ∅ = (8 in.)	2	15.24	-5.00	5.60		0.28	0.53						
T_D = 25.6°C (78°F)	3	30.48	-5.00	5.70		0.30	0.55						
T_W = 14.4°C (58°F)	4	45.72	-5.00	6.20		0.32	0.57						
	5	60.96	-4.50	5.70		0.32	0.57						
Average			-4.80	5.96	10.76	0.29	0.54	0.0734	2,185.99	666.30	0.657	437.64	30.90
Fan 3	1	5.08	-0.33	2.30		1.50	1.22						
Sheave ∅ = (7 in.)	2	15.24	-0.40	2.45		1.20	1.10						
T_D = 27.8°C (82°F)	3	30.48	-0.55	2.20		1.10	1.05						
T_W = 16.7°C (62°F)	4	45.72	-0.70	2.15		0.93	0.96						
	5	60.96	-0.68	2.05		0.83	0.91						
Average			-0.53	2.23	2.76	1.11	1.05	0.0738	4,240.16	1,292.42	0.657	848.89	60.23

TABLE B-4. AIRFLOW, MIDDLE--TACOMA, WASHINGTON

		Air flows, pressure drops											
Date 5/9/79 Baro. press. 30.15 in Hg	Point	Traverse location (cm)	Total pressure		Pressure drop (in H_2O)	Velocity pressure inlet Δh_1 (in H_2O)	$\sqrt{\Delta h_1}$	Air density αGA (lb/ft^3)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m^2)	Airflow rate (m^3/min)	Airflow rate (Mg/h)
			Inlet Δh (in H_2O)	Outlet Δh (in H_2O)									
Fan 1	1	5.08	-0.55	2.70		2.30	1.52						
Sheave ∅ = (8")	2	15.24	-0.90	2.80		2.10	1.45						
T_D = 31.4°C (88.5°F)	3	30.48	-1.50	2.70		1.45	1.20						
T_W = 17.2°C (63.0°F)	4	45.72	-1.90	2.55		1.25	1.12						
	5	60.96	-1.65	2.50		1.60	1.26						
Average			-1.30	2.65	3.95	1.74	1.31	0.0732	5,308.69	1,681.10	0.657	1,062.81	74.88
Fan 2	1	5.08	-5.44	3.20		0.17	0.41						
Sheave ∅ = (8")	2	15.24	-5.44	2.15		0.17	0.41						
T_D = 28.3°C (83.0°F)	3	30.48	-5.44	2.80		0.18	0.42						
T_W = 15.0°C (59.0°F)	4	45.72	-6.12	3.20		0.19	0.44						
	5	60.96	-6.12	3.25		0.19	0.44						
Average			-5.71	2.92	8.63	0.18	0.42	0.0731	1,704.02	519.39	0.657	341.15	23.98
Fan 3	1	5.08	-0.57	2.70		1.60	1.26						
Sheave ∅ = (8")	2	15.24	-0.63	2.80		1.50	1.22						
T_D = 31.4°C (88.5°F)	3	30.48	-0.87	2.70		1.30	1.14						
T_W = 17.2°C (63.0°F)	4	45.72	-1.00	2.55		1.10	1.05						
	5	60.96	-1.10	2.50		1.20	1.10						
Average			-0.83	2.65	3.48	1.34	1.15	0.0733	4,657.77	1,419.71	0.657	932.50	65.77

X

TABLE B-5. AIRFLOW, HIGHEST--TACOMA, WASHINGTON

Date 5/8/79 Baro. press. 29.92 in Hg	Point	Traverse location (cm)	Inlet Δh (in H_2O)	Outlet Δh (in H_2O)	Air flows, pressure drops: Pressure drop (in H_2O)	Velocity pressure inlet Δh_i (in H_2O)	$\sqrt{\Delta h_i}$	Air density αA (lb/ft³)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m²)	Airflow rate (m³/min)	Air flow rate (Mg/h)
Fan 1	1	5.08	-0.65	2.50		3.00	1.73						
Sheave ø = (9 in.)	2	15.24	-0.98	2.00		2.70	1.64						
T_D = 29.4°C (85°F)	3	30.48	-1.75	1.60		2.00	1.41						
T_W = 17.8°C (64°F)	4	45.72	-2.20	1.50		1.70	1.30						
	5	60.96	-1.70	0.45		2.20	1.48						
Average			-1.46	1.61	3.07	2.32	1.51	0.0732	6,121.11	1,865.74	0.657	1,225.46	86.29
Fan 2	1	5.08	-9.70	5.00		0.25	0.50						
Sheave ø = (8 in.)	2	15.24	-9.80	3.70		0.25	0.50						
T_D = 26.7°C (80°F)	3	30.48	-9.75	4.00		0.26	0.51						
T_W = 16.1°C (61°F)	4	45.72	-9.75	4.40		0.26	0.51						
	5	60.96	-9.75	4.10		0.24	0.49						
Average			-9.75	4.24	13.99	0.25	0.50	0.0723	2,039.14	621.54	0.657	408.24	28.40
Fan 3	1	5.08	-0.70	3.65		2.15	1.47						
Sheave ø = (9 1/4 in.)	2	15.24	-0.85	3.60		1.95	1.40						
T_D = 29.4°C (85°F)	3	30.48	-1.20	3.45		1.80	1.34						
T_W = 17.7°C (64°F)	4	45.72	-1.30	3.25		1.60	1.26						
	5	60.96	-1.20	3.15		1.40	1.18						
Average			-1.05	3.42	4.47	1.78	1.33	0.0733	5,388.72	1,642.50	0.657	1,078.84	76.04

TABLE B-6. PARTICLE SIZE DISTRIBUTION--TACOMA WASHINGTON

		Lights			Heavies		
Run No.	Screen size (cm)	Total weight (g)	% Retained	Cumulative % passing	Total weight (g)	% Retained	Cumulative % passing
1	+10.16	64.99	1.20	98.80	0	0	100
	+ 5.08	260.17	4.82	93.98	139.95	6.81	93.19
	+ 2.54	869.33	16.09	77.89	583.44	28.38	64.81
	+ 1.59	378.37	7.00	70.89	185.02	9.00	55.81
	+ 0.95	662.37	12.26	58.63	236.99	11.53	44.28
	- 0.95	3,166.31	58.62		910.06	44.28	
	Total	5,401.54			2,055.46		
2	+10.16	276.51	8.71	91.29	0	0	100
	+ 5.08	341.23	10.75	80.54	372.34	14.87	85.13
	+ 2.54	661.92	20.85	59.69	553.27	22.09	63.04
	+ 1.59	323.16	10.18	49.51	238.20	9.51	53.53
	+ 0.95	363.62	11.46	38.05	332.01	13.26	40.27
	- 0.95	1,207.58	38.05		1,008.57	40.27	
	Total	3,174.02			2,504.39		
3	+10.16	119.73	2.62	97.38	378.81	8.19	91.81
	+ 5.08	952.61	20.88	76.50	1,455.35	31.46	60.35
	+ 2.54	835.83	18.32	58.18	812.34	17.56	42.79
	+ 1.59	458.96	10.06	48.12	407.39	8.81	33.98
	+ 0.95	467.16	10.24	37.88	495.67	10.72	23.26
	- 0.95	1,726.96	37.86		1,075.89	23.26	
	Total	4,561.25			4,625.45		
4	+10.16	180.05	3.40[a/]	96.60[b/]	263.08	4.04	95.96
	+ 5.08	472.84	8.93	87.67[b/]	1,417.27	21.78	74.18
	+ 2.54	873.19	16.50	71.17[b/]	1,387.92	21.33	52.85
	+ 1.59	343.60	6.49	64.68[b/]	1,129.21	17.35	35.50
	+ 0.95	576.50	10.89	53.79[b/]	900.37	13.84	21.66
	- 0.95	2,845.91	53.78		1,409.03	21.65	
	Total	5,292.09			6,506.88		

(continued)

179

TABLE B-6. (continued)

		Lights			Heavies		
Run No.	Screen size (cm)	Total weight (g)	% Retained	Cumulative % passing	Total weight (g)	% Retained	Cumulative % passing
5	+10.16	221.58	3.63	96.37	94.64	3.66	96.34
	+ 5.08	549.48	9.00	87.37	506.79	19.58	76.76
	+ 2.54	1,041,31	17.06	70.31	696.52	26.75	50.01
	+ 1.59	501.02	8.21	62.10	208.49	8.05	41.96
	+ 0.95	297.00	4.86	57.24	210.04	8.11	33.85
	- 0.95	3,495.00	57.24		875.92	33.84	
	Total	6,105.39			2,588.40		
6	+10.16	322.62	6.30	93.70	96.85	1.87	98.13
	+ 5.08	539.22	10.53	83.17	1,188.37	22.90	75.23
	+ 2.54	983.57	19.22	63.95	1,318.96	25.41	49.82
	+ 1.59	218.41	4.27	59.68	453.32	8.73	41.09
	+ 0.95	454.63	8.88	50.80	487.20	9.39	31.70
	- 0.95	2,600.00	50.80		1,645.41	31.70	
	Total	5,118.45			5,190.12		
7	+10.16	85.50	1.64	98.36	66.08	1.02	98.98
	+ 5.08	531.55	10.21	88.15	2,127.13	32.69	66.29
	+ 2.54	1,168.07	22.43	65.72	1,300.76	19.99	46.30
	+ 1.59	450.75	8.66	57.06	681.44	10.47	35.83
	+ 0.95	612.40	11.76	45.30	667.11	10.25	25.58
	- 0.95	2,358.62	45.30		1,663.91	25.57	
	Total	5,206.89			6,506.43		
8	+10.16	239.50	5.32	94.68	332.25	5.91	94.09
	+ 5.08	551.93	12.26	82.42	1,868.39	33.25	60.84
	+ 2.54	1,039.50	23.09	59.33	1,250.99	22.27	38.57
	+ 1.59	447.07	9.93	49.40	455.52	8.11	30.46
	+ 0.95	577.76	12.84	36.56	437.69	7.79	22.67
	- 0.95	1,645.36	36.55		1,273.63	22.67	
	Total	4,501.12			5,618.46		
9	+10.16	275.70	6.58	93.42	310.18	3.92	96.08
	+ 5.08	595.01	14.21	79.21	2,708.50	34.25	61.83
	+ 2.54	974.82	23.28	55.93	1,845.26	23.33	38.50
	+ 1.59	232.68	5.56	50.37	1,006.68	12.73	25.77
	+ 0.95	335.31	8.01	42.36	735.72	9.30	16.47
	- 0.95	1,773.61	42.36		1,302.27	16.47	
	Total	4,187.13			7,908.61		

(continued)

TABLE B-6. (concluded)

Run No.	Screen size (cm)	Lights Total weight (g)	Lights % Retained	Lights Cumulative % passing	Heavies Total weight (g)	Heavies % Retained	Heavies Cumulative % passing
10	+10.16	0	0	100	0	0	100
	+ 5.08	668.93	15.76	84.24	851.39	21.17	78.83
	+ 2.54	584.71	13.78	70.46	1,325.92	32.96	45.87
	+ 1.59	327.61	7.72	62.74	308.07	7.66	38.21
	+ 0.95	386.33	9.10	53.64	453.78	11.28	26.93
	- 0.95	2,276.47	53.64		1,083.25	26.93	
	Total	4,244.05			4,022.41		
11	+10.16	64.61	1.59	98.41	62.63	1.54	98.46
	+ 5.08	356.83	8.75	89.66	588.04	14.49	83.97
	+ 2.54	773.65	18.98	70.68	1,219.51	30.05	53.92
	+ 1.59	565.67	13.88	56.80	397.36	9.79	44.13
	+ 0.95	579.94	14.23	42.57	439.23	10.82	33.31
	- 0.95	1,735.56	42.58		1,352.08	33.31	
	Total	4,076.26			4,058.85		
12	+10.16	127.48	4.71	95.29	181.30	6.61	93.39
	+ 5.08	284.93	10.53	84.76	1,101.85	40.16	53.23
	+ 2.54	607.37	22.45	62.31	380.96	13.88	39.35
	+ 1.59	373.46	13.80	48.51	163.33	5.95	33.40
	+ 0.95	316.61	11.70	36.81	227.29	8.28	25.12
	- 0.95	995.83	36.81		689.14	25.12	
	Total	2,705.68			2,743.87		
13	+10.16	0	0	100	146.17	2.67	97.33
	+ 5.08	337.09	12.13	87.87	1,360.20	24.86	72.47
	+ 2.54	613.46	22.08	65.79	1,048.00	19.16	53.31
	+ 1.59	210.90	7.59	58.20	387.31	7.08	46.23
	+ 0.95	297.42	10.70	47.50	617.60	11.29	34.94
	- 0.95	1,319.75	47.50		1,911.83	34.94	
	Total	2,778.62			5,471.11		
14	+10.16	71.64	2.82	97.18	168.52	4.01	95.99
	+ 5.08	323.37	12.71	84.47	853.19	20.29	75.70
	+ 2.54	506.77	19.92	64.55	913.72	21.73	53.97
	+ 1.59	252.94	9.94	54.61	486.23	11.56	42.41
	+ 0.95	339.75	13.35	41.26	480.80	11.43	30.98
	- 0.95	1,050.00	41.27		1,302.86	30.98	
	Total	2,544.47			4,205.32		

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a/ This number read "3.41" on the data sheet.

b/ These numbers were corrected to correspond with the % retained column.

TABLE B-7. SAMPLE COMPOSITION--TACOMA, WASHINGTON

Run No.	Sheave sizes (cm)			Screen size (cm)	Lights						Heavies					
	Fan 1	Fan 2	Fan 3		PP wt. (g)	Aluminum wt. (g)	Ferrous wt. (g)	Other wt. (g)	Total wt. (g)	14 Mesh grit (g)	PP wt. (g)	Aluminum wt. (g)	Ferrous wt. (g)	Other wt. (g)	Total wt. (g)	14 Mesh grit (g)
1	17.78	17.78	17.78	+10.16	64.99	0.0	0.0	0.0	64.99		0.0	0.0	0.0	0.0	0.0	
				+5.08	243.34	0.0	0.0	16.83	260.17		59.22	19.67	0.0	61.06	139.95	
				+2.54	813.89	2.12	30.75	22.57	869.33		189.27	124.47	200.41	69.29	583.44	
				+1.59	60.74	0.0	0.0	2.41	63.15		82.21	18.27	7.69	76.85	185.02	
				+0.95	93.66	0.0	0.0	16.89	110.55		116.12	0.37	0.0	120.50	236.99	
				-0.95	6.39	0.0	0.0	8.46	14.85		6.2	0.0	0.0	10.09	16.29	
				Total	1,283.01	2.12	30.75	67.16	1,383.04	1,090.05	453.02	162.78	208.10	337.79	1,161.69	192.67
2	17.78	17.78	17.78	+10.16	118.75	0.0	0.0	157.76	276.51		0.0	0.0	0.0	0.0	0.0	
				+5.08	264.28	18.86	58.09	0.0	341.23		209.98	26.18	136.18	0.0	372.34	
				+2.54	564.49	19.79	41.33	36.31	661.92		247.06	0.0	198.52	107.69	553.27	
				+1.59	59.91	1.95	0.0	10.01	71.87		76.35	0.0	13.85	66.68	156.88	
				+0.95	74.85	0.57	0.0	5.45	80.87		105.09	1.90	25.54	86.13	218.66	
				-0.95	8.54	0.0	0.0	7.40	15.94		13.59	0.0	0.0	11.12	24.71	
				Total	1,090.82	41.17	99.42	216.93	1,448.34		652.07	28.08	374.09	271.62	1,325.86	
3	17.78	17.78	17.78	+10.16	119.73	0.0	0.0	0.0	119.73		378.81	0.0	0.0	0.0	378.81	
				+5.08	833.42	46.44	62.50	10.25	952.61		376.31	34.08	1,028.26	16.70	1,455.35	
				+2.54	739.87	48.65	0.0	47.31	835.83		421.40	76.30	180.91	133.73	812.34	
				+1.59	96.48	0.0	0.0	6.51	102.99		113.80	0.95	39.02	45.85	199.62	
				+0.95	97.08	0.0	0.0	7.75	104.83		140.40	1.54	0.71	100.23	242.88	
				-0.95	10.02	0.0	0.0	9.84	19.86		18.67	0.07	0.0	23.65	42.89	
				Total	1,896.60	95.09	62.50	81.66	2,135.85	537.17	1,449.39	112.94	1,248.90	320.16	3,131.39	178.22
4	17.78	17.78	17.78	+10.16	0.0	0.0	0.0	180.05	180.05		153.83	0.0	0.0	109.25	263.08	
				+5.08	274.40	0.0	73.30	125.14	472.84		234.12	66.46	950.31	166.38	1,417.27	
				+2.54	729.19	62.04	31.48	50.48	873.19		469.95	72.90	490.83	354.24	1,387.92	
				+1.59	46.86	1.81	0.0	1.77	50.44		374.67	6.37	15.90	91.78	488.72	
				+0.95	70.83	1.19	0.0	12.61	84.63		118.16	21.25	47.55	202.72	389.68	
				-0.95	8.41	0.0	0.0	9.69	18.10		7.80	0.26	0.0	37.17	45.23	
				Total	1,129.69	65.04	104.78	379.74	1,679.25		1,358.53	167.24	1,504.59	961.54	3,991.90	

(continued)

TABLE B-7. (continued)

Run No.	Sheave sizes (cm) Fan 1	Fan 2	Fan 3	Screen size (cm)	Lights PP wt. (g)	Lights Aluminum wt. (g)	Lights Ferrous wt. (g)	Lights Other wt. (g)	Lights Total wt. (g)	Lights 14 Mesh grit (g)	Heavies PP wt. (g)	Heavies Aluminum wt. (g)	Heavies Ferrous wt. (g)	Heavies Other wt. (g)	Heavies Total wt. (g)	Heavies 14 Mesh grit (g)
5	17.78	17.78	17.78	+10.16	219.52	0.0	0.0	2.06	221.58		94.64	0.0	0.0	0.0	94.64	
				+5.08	534.88	0.0	9.04	5.56	549.48		139.63	53.59	287.56	44.01	506.79	
				+2.54	877.33	21.13	26.14	116.71	1,041.31		354.56	40.44	149.23	418.29	692.52	
				+1.59	97.46	0.0	0.0	10.96	108.42		108.78	10.47	21.74	51.78	192.77	
				+0.95	57.62	0.0	0.0	6.65	64.27		120.17	0.0	0.0	74.03	194.20	
				-0.95	2.43	0.0	0.0	4.56	6.99		13.60	0.0	0.0	13.51	27.11	
				Total	1,789.24	21.13	35.18	146.50	1,992.05	1,566.22	831.38	86.50	458.53	331.62	1,708.03	91.09
6	22.86	17.78	23.50	+10.16	153.44	0.0	169.18	0.0	322.62		96.85	0.0	0.0	0.0	96.85	
				+5.08	442.20	0.95	94.94	1.13	539.22		258.77	0.0	886.34	43.26	1,188.37	
				+2.54	747.10	104.56	7.50	124.41	983.57		431.94	291.14	895.07	200.81	1,318.96	
				+1.59	53.86	0.89	0.0	4.22	58.97		55.07	29.96	47.72	138.61	271.36	
				+0.95	111.80	0.0	0.0	10.95	122.75		102.38	2.31	16.67	170.28	291.64	
				-0.95	10.69	0.0	0.0	31.95	42.64		8.43	0.08	0.58	26.76	35.85	
				Total	1,519.09	106.40	271.62	172.66	2,069.77		953.44	323.49	1,346.38	579.72	3,203.03	
7	22.86	17.78	23.50	+10.16	85.50	0.0	0.0	0.0	85.50		34.96	0.0	31.12	0.0	66.08	
				+5.08	382.18	0.0	126.59	22.78	531.55		229.71	592.58	1,213.41	91.43	3,127.13	
				+2.54	937.51	27.52	87.75	115.19	1,167.97		406.01	108.30	491.90	294.55	1,300.76	
				+1.59	188.81	0.61	8.80	14.22	212.44		105.49	26.78	101.01	132.45	365.73	
				+0.95	106.73	1.31	1.20	23.65	132.89		109.01	6.23	64.50	178.30	358.04	
				-0.95	1.74	0.04	0.11	4.95	6.84		6.15	0.08	0.0	5.85	12.08	
				Total	1,702.47	29.48	224.45	180.79	2,137.19		891.33	733.97	1,901.94	702.58	4,229.82	
8	22.86	17.78	23.50	+10.16	239.50	0.0	0.0	0.0	239.50		83.60	0.0	0.0	248.65	332.25	
				+5.08	479.09	0.0	0.0	72.85	551.93		273.58	67.11	1,322.20	205.50	1,868.39	
				+2.54	825.02	21.00	86.71	106.77	1,039.50		452.67	124.32	435.58	238.42	1,250.99	
				+1.59	153.38	0.41	0.0	21.91	175.70		120.52	21.80	40.67	94.65	277.64	
				+0.95	190.65	2.56	0.0	33.85	227.06		113.97	15.44	9.92	127.44	266.77	
				-0.95	5.66	0.05	0.0	10.25	15.96		3.93	0.24	0.0	7.42	11.59	
				Total	1,893.30	24.02	86.71	245.63	2,249.66		1,048.27	228.91	1,808.37	922.08	4,007.63	

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3/8"
PAGE NUMBER
EPA Form 2350-6 (4-80)
TYPING GUIDE SHEET

183

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TOP OF IMAGE AREA
DROPPED HEAD: BEGIN SECTIONS HERE

TABLE B-7. (continued)

Run	Sheave sizes (cm)			Screen size	Lights						Heavies					
No.	Fan 1	Fan 2	Fan 3	(cm)	PP wt. (g)	Aluminum wt. (g)	Ferrous wt. (g)	Other wt. (g)	Total wt. (g)	14 Mesh grit (g)	PP wt. (g)	Aluminum wt. (g)	Ferrous wt. (g)	Other wt. (g)	Total wt. (g)	14 Mesh grit (g)
9	22.86	17.78	23.50	+10.16	275.20	0.0	0.0	0.0	275.70		171.91	0.0	138.27	0.0	310.18	
				+5.08	564.22	11.87	0.0	18.92	595.01		408.95	262.46	1,371.68	655.41	2,708.50	
				+2.54	779.55	37.10	50.78	107.39	974.82		575.05	121.67	525.27	626.27	1,848.26	
				+1.59	86.64	0.77	0.0	6.43	93.84		143.78	5.34	25.76	276.01	450.89	
				+0.95	94.32	0.0	6.9	34.01	135.23		94.97	6.82	18.52	209.22	329.53	
				-0.95	3.46	0.0	0.0	9.31	12.77		6.77	0.0	0.0	16.15	22.92	
				Total	1,803.89	49.74	57.68	176.06	2,087.37	817.53	1,401.43	396.29	2,079.50	1,793.06	5,670.28	160.03
10	22.86	17.78	23.50	+10.16	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
				+5.08	534.03	18.82	36.45	79.63	668.93		152.06	0.0	699.33	0.0	851.39	
				+2.54	536.77	0.0	8.12	39.82	584.71		333.04	76.58	648.26	268.04	1,325.92	
				+1.59	73.89	0.0	13.97	10.62	98.48		70.72	0.0	2.06	70.78	143.56	
				+0.95	97.43	1.20	3.41	14.09	116.13		99.18	0.63	10.17	101.48	211.46	
				-0.95	9.07	0.0	0.0	14.15	23.22		10.91	0.29	0.0	10.79	21.99	
				Total	1,251.19	20.02	61.95	158.31	1,491.47	1,133.47	655.91	77.50	1,359.82	451.09	2,554.32	295.67
11	20.32	17.78	20.32	+10.16	5.63	0.0	0.0	58.98	64.61		62.63	0.0	0.0	0.0	62.63	
				+5.08	247.84	73.08	0.0	35.91	356.83		250.16	12.02	309.79	16.07	588.04	
				+2.54	703.80	3.83	10.19	55.83	773.65		506.76	104.62	472.63	135.50	1,219.51	
				+1.59	88.26	0.0	0.0	8.47	96.73		73.29	8.42	10.70	51.83	144.24	
				+0.95	86.89	1.04	0.0	11.24	99.17		93.08	1.57	1.50	63.29	159.44	
				-0.95	2.78	0.0	0.0	5.03	7.81		3.00	0.0	0.0	3.49	6.49	
				Total	1,135.20	77.95	10.19	175.46	1,398.80		988.92	126.63	794.62	270.18	2,180.35	
12	20.32	17.78	20.32	+10.16	105.24	0.0	0.0	22.24	127.48		175.38	5.92	0.0	0.0	181.30	
				+5.08	249.34	0.0	0.0	35.59	284.93		222.35	50.39	666.61	162.50	1,101.85	
				+2.54	537.56	15.07	33.09	21.65	607.37		142.93	31.43	151.60	55.00	380.96	
				+1.59	191.76	0.0	0.0	14.39	200.15		45.87	1.46	14.13	101.87	163.33	
				+0.95	154.07	0.0	2.01	18.69	174.77		58.43	1.20	5.31	162.35	227.29	
				-0.95	5.01	0.02	0.0	14.66	19.69		4.63	0.74	0.0	44.11	49.48	
				Total	1,242.98	15.09	35.10	127.27	1,420.39		649.59	91.14	837.65	525.83	2,104.21	

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3/8"
PAGE NUMBER
EPA Form 2350-4 (4-80)
(PREVIOUSLY CIN. EPA FORM 237)
TYPING GUIDE SHEET

TABLE B-7. (concluded)

Run No.	Sheave sizes (cm) Fan 1	Fan 2	Fan 3	Screen size (cm)	Lights PP wt. (g)	Lights Aluminum wt. (g)	Lights Ferrous wt. (g)	Lights Other wt. (g)	Lights Total wt. (g)	Lights 14 Mesh grit (g)	Heavies PP wt. (g)	Heavies Aluminum wt. (g)	Heavies Ferrous wt. (g)	Heavies Other wt. (g)	Heavies Total wt. (g)	Heavies 14 Mesh grit (g)
13	20.32	17.78	20.32	+10.16	0.0	0.0	0.0	0.0	0.0		146.17	0.0	0.0	0.0	146.17	
				+5.08	337.09	0.0	0.0	0.0	337.09		243.76	51.06	1,103.11	0.0	1,397.93[a]	1,360.20
				+2.54	497.13	48.04	34.75	33.54	613.46		549.60	77.97	241.89	178.54	1,048.00	
				+1.59	54.42	0.0	2.08	6.39	62.89		111.80	1.64	21.61	104.62	239.67	
				+0.95	75.97	0.30	0.0	12.42	88.69		134.73	5.47	4.81	237.16	382.17	
				-0.95	7.66	0.0	0.0	13.72	21.38		8.74	0.0	0.0	7.74	16.48	
				Total	972.27	48.34	36.83	66.07	1,123.51		1,194.80	136.14	1,371.42	528.06	3,230.42	339.14
14	20.32	17.78	20.32	+10.16	18.56	0.0	0.0	53.08	71.64		21.53	0.95	1.22	144.82	168.52	
				+5.08	256.50	0.0	53.75	13.12	323.37		214.73	52.00	459.12	127.34	853.19	
				+2.54	458.74	2.94	18.46	26.63	506.77		417.85	40.73	269.75	185.39	913.72	
				+1.59	79.68	0.0	0.0	2.78	82.46		103.94	4.26	20.52	39.42	168.14	
				+0.95	94.88	0.94	0.0	14.94	110.76		108.97	1.15	1.36	54.78	166.26	
				-0.95	2.11	0.0	0.0	5.66	7.77		3.15	0.06	0.03	5.88	9.12	
				Total	910.47	3.88	72.21	116.21	1,102.77		870.17	99.15	752.00	557.63	2,278.95	

[a] 1,397.93 is true total
1,360.20 is received total

EPA Form 2350-4 (4-80)
(PREVIOUSLY CIN. EPA FORM 261)
TYPING GUIDE SHEET

TABLE B-8. MOISTURE CONTENT, INITIAL TO AIR DRIED CONDITION--TACOMA WASHINGTON

Run No.	Lights Initial weight (g)	Lights Final weight (g)	Lights Moisture weight (g)	Lights Moisture content (%)	Heavies Initial weight (g)	Heavies Final weight (g)	Heavies Moisture weight (g)	Heavies Moisture content (%)
1	8,002.00	5,455.00	2,547.00	31.8	2,809.00	2,074.00	735.00	26.2
2	4,256.25	3,234.75	1,021.50	24.0	4,006.00	2,614.00	1,392.00	34.8
3	7,122.00	4,654.00	2,468.00	34.7	6,611.00	4,682.00	1,929.00	29.2
4	8,011.00	5,426.00	2,585.00	32.3	8,664.00	6,534.00	2,130.00	24.6
5	9,194.00	6,129.00	3,065.00	33.3	3,859.00	2,639.00	1,220.00	31.6
6	6,810.00	5,142.00	1,668.00	24.5	6,498.00	5,256.00	1,242.00	19.1
7	6,924.00	5,221.00	1,703.00	24.6	8,115.00	6,534.00	1,581.00	19.5
8	6,157.00	4,568.00	1,589.00	25.8	7,065.00	5,653.00	1,412.00	20.0
9	5,590.00	4,171.00	1,419.00	25.4	9,335.00	7,973.00	1,362.00	14.6
10	5,938.00	4,261.00	1,677.00	28.2	5,107.50	4,029.25	1,078.25	21.1
11	5,789.00	4,200.00	1,589.00	27.4	5,221.00	4,176.00	1,045.00	20.0
12	3,547.00	2,696.00	851.00	24.0	3,377.00	2,670.00	707.00	20.9
13	3,864.00	2,784.00	1,080.00	27.4	7,034.00	5,505.00	1,529.00	21.8
14	3,660.00	2,582.00	1,078.00	29.4	5,930.00	4,256.00	1,674.00	28.2

EPA Form 2350-4 (4-80)
(PREVIOUSLY CIN; EPA FORM 267)
TYPING GUIDE SHEET

TABLE B-9. POWER MEASUREMENTS--TACOMA , WASHINGTON

Sheave sizes (cm)			Power (loaded)	Power (no load)			Conveyors (kW)					Cyclone air lock (kW)	Total (kW)
Fan 1	Fan 2	Fan 3	Fan 1 (kW)	Fan 1 (kW)	Fan 2 (kW)	Fan 3 (kW)	Recirculating discharge	Cyclone output	Recirculating 1	Recirculating 2	Recirculating 3		
17.78	17.78	17.78	19.8	21.7	44.5	18.0	0.6	1.0	0.7	0.8	0.7	1.3	89.2
22.86	17.78	23.50	41.0	42.0	44.0	35.0	0.6	1.0	0.7	0.8	0.7	1.3	126.1
20.32	17.78	20.32	26.0	26.7	42.0	24.7	0.6	1.0	0.7	0.8	0.7	1.3	98.5

APPENDIX C

FIELD TEST DATA FOR VERTICAL CYLINDRICAL AIR CLASSIFIER WITH DISPERSION CONE--BALTIMORE COUNTY, MARYLAND

TABLE C-1. SUMMARY OF OPERATIONAL DATA--BALTIMORE , MARYLAND

Run No.	Input feed rate (Mg/h)	Lights feed rate (Mg/h)	Split percent lights	Air setting (m^3/min)	Ash percent in lights	Ash percent in heavies	Paper + plastic percent in lights	Lights[a] percent moisture content	Paper + plastic percent in heavies	Higher heating Value,[b] kJ/kg	
										Lights	Heavies
1	39.40	23.38	59.35	1686.45	22.9	61.2	55.2	27.2	17.70		
2	4.52	3.36	74.32	1686.45	22.1	56.1	66.6	25.8	25.49	14,610	8,027
3	6.19	5.38	87.02	1686.45	19.2	51.5	59.3	38.1	7.57	10,972	10,093
4	14.71	7.52	51.16	1686.45	-	-	-	-	-		
5	8.69	6.19	71.26	1686.45	-	-	-	-	-		
6	21.68	14.58	67.28	1686.45	16.0	50.9	77.4	25.2	43.26		
7	51.32	25.58	49.85	1686.45	-	-	-	-	-		
8	10.62	8.57	80.67	1686.45	-	-	-	-	-		
9	34.59	17.19	49.70	1686.45	28.2	42.8	51.4	30.8	45.77	15,119	11,279
10	66.98	51.63	77.09	2307.42	23.7	53.2	50.0	30.4	31.97		
11	96.38	59.84	62.09	2307.4	32.2	51.6	63.6	25.4	33.22		
12	32.10	26.12	81.38	2307.4	24.0	74.3	62.2	33.4	8.60	14,203	6,473
13	1.42	1.08	76.36	2307.4	-	-	-	-	-		
14	10.29	9.09	88.30	2307.4	23.5	68.0	59.5	32.0	5.99	6,778	5,064
15	38.08	29.69	77.98	2307.4	20.0	66.8	69.1	32.7	22.54		
16	105.23	52.72	50.11	2307.4	-	-	-	-	-		
17	34.97	29.28	83.74	1908.61	-	-	-	-	-		
18	13.20	10.42	78.92	1908.61	-	-	-	-	-		
19	116.05	59.84	51.57	1908.61	-	-	-	-	-		
20	54.73	39.65	72.45	1908.61	-	-	-	-	-		
21	75.16	44.16	58.75	1908.61	-	-	-	-	-		
22	114.56	47.43	41.40	1908.61	-	-	-	-	-		
23	23.11	15.69	67.87	1908.61	31.5	67.4	68.2	23.7	24.93	8,150	7,459
24	83.76	42.77	51.06	1908.61	-	-	-	-	-		
25	90.16	40.02	44.39	1980.61	26.2	49.7	67.9	35.1	35.46		
26	2.11	1.79	85.18	1908.61	-	-	-	-	-		
27	53.09	21.82	41.10	1908.61	19.5	40.2	78.5	30.5	61.93		
28	96.07	41.56	43.26	1908.61	28.1	32.2	73.2	26.7	51.08	13,661	12,421
29	55.45	27.84	50.20	1908.61	35.4	36.8	66.7	28.0	31.34		
30	19.01	16.26	85.57	1908.61	18.8	73.5	70.0	27.6	5.03	12,628	4,687
31	11.48	10.59	92.23	1908.61	-	-	-	-	-		
32	26.94	14.76	54.79	1980.61	-	-	-	-	-		

[a] From initial to air-dried condition.

[b] Oven dried basis.

TABLE C-2. FEED RATES--BALTIMORE MARYLAND

			Lights						Heavies						Input
Date 1979	Airflow setting (m^3/min)	Run no.	Sample weight (kg)	Tare weight (kg)	Balance weight (kg)	Sample length (m)	Belt speed (m/min)	Feed rate (Mg/h)	Sample weight (kg)	Tare weight (kg)	Balance weight (kg)	Sample length (m)	Belt speed (m/min)	Feed rate (Mg/h)	Feed rate (Mg/h)
5-21	1st Air Flow 1686.45	1	11.58	0.11	11.46	2.44	82.91	23.38	10.24	0.06	10.19	1.52	39.93	16.01	39.40
5-21		2	1.70	0.06	1.65	2.44	82.91	3.36	0.79	0.06	0.74	1.52	39.93	1.16	4.52
5-21		3	2.70	0.06	2.64	2.44	82.91	5.38	0.57	0.06	0.51	1.52	39.93	0.80	6.19
5-21		4	3.75	0.06	3.69	2.44	82.91	7.52	4.63	0.06	4.57	1.52	39.93	7.90	14.71
5-21		5	3.09	0.06	3.04	2.44	82.91	6.19	1.65	0.06	1.59	1.52	39.93	2.50	8.69
5-21		6	7.21	0.06	7.15	2.44	82.91	14.58	4.57	0.06	4.51	1.52	39.93	7.09	21.68
5-21		7	12.60	0.06	12.54	2.44	82.91	25.58	16.43	0.06	16.37	1.52	39.93	25.74	51.32
5-21		8	4.26	0.06	4.20	2.44	82.91	8.57	1.36	0.06	1.31	1.52	39.93	2.05	10.62
5-21		9	8.48	0.06	8.43	2.44	82.91	17.19	11.12	0.06	11.07	1.52	39.93	17.40	34.59
5-22	2nd Air Flow 2307.04	10	23.95	0.23	23.72	2.29	82.91	51.63	9.82	0.06	9.76	1.52	39.93	15.34	66.98
5-22		11	27.61	0.11	27.50	2.29	82.91	59.84	23.35	0.11	23.24	1.52	39.93	36.53	96.38
5-22		12	12.06	0.06	12.00	2.29	82.91	26.12	3.86	0.06	3.80	1.52	39.93	5.98	32.10
5-22		13	0.65	0.06	0.60	2.74	82.91	1.08	0.48	0.06	0.43	3.05	39.93	0.33	1.42
5-22		14	4.51	0.06	4.45	2.44	82.91	9.09	1.59	0.06	1.53	3.05	39.93	1.20	10.29
5-22		15	14.67	0.11	14.56	2.44	82.91	29.69	5.39	0.06	5.33	1.52	39.93	8.39	38.08
5-22		16	25.96	0.11	25.85	2.44	82.91	52.72	33.51	0.11	33.40	1.52	39.93	52.50	105.23
5-23	3rd Air Flow, 1st Set 1908.61	17	14.47	0.11	14.36	2.44	82.91	29.28	7.35	0.11	7.24	3.05	39.93	5.69	34.97
5-23		18	5.16	0.06	5.11	2.44	82.91	10.42	3.60	0.06	3.55	3.05	39.93	2.78	13.20
5-23		19	27.67	0.17	27.50	2.29	82.91	59.84	35.92	0.17	35.75	1.52	39.93	56.20	116.05
5-23		20	18.33	0.11	18.22	2.29	82.91	39.65	9.65	0.06	9.59	1.52	39.93	15.08	54.73
5-23		21	20.46	0.17	20.29	2.29	82.91	44.16	19.83	0.11	19.72	1.52	39.93	31.00	75.16
5-23		22	21.96	0.17	21.79	2.29	82.91	47.43	42.87	0.17	42.70	1.52	39.93	67.13	114.56
5-23	3rd Air Flow, 2nd Set 1908.61	23	7.26	0.06	7.21	2.29	82.91	15.69	9.51	0.06	9.45	3.05	39.93	7.43	23.11
5-23		24	21.08	0.11	20.97	2.44	82.91	42.77	26.19	0.11	26.08	1.52	39.93	40.99	83.76
5-23		25	18.56	0.17	18.39	2.29	82.91	40.02	32.01	0.11	31.89	1.52	39.93	50.14	90.16
5-23		26	0.94	0.06	0.88	2.44	82.91	1.79	0.45	0.06	0.40	3.05	39.93	0.31	2.11
5-23		27	10.75	0.06	10.70	2.44	82.91	21.82	20.00	0.11	19.89	1.52	39.93	31.27	53.09
5-23		28	19.21	0.11	19.10	2.29	82.91	41.56	34.84	0.17	34.67	1.52	39.93	54.51	96.07
5-23		29	13.76	0.11	13.65	2.44	82.91	27.84	17.62	0.06	17.56	1.52	39.93	27.61	55.45
5-23		30	8.03	0.06	7.97	2.44	82.91	16.26	3.55	0.06	3.49	3.05	39.93	2.74	19.01
5-23		31	5.25	0.05	5.19	2.44	82.91	10.59	1.19	0.06	1.14	3.05	39.93	0.89	11.48
5-23		32	7.29	0.06	7.24	2.44	82.91	14.76	7.80	0.06	7.75	1.52	39.93	12.18	26.94

Note: Sample weight minus tare weight may be slightly different than balance weight because of round-off.
Lights feed rate plus heavies feed rate may be slightly different than infeed rate because of round-off.

TYPING GUIDE SHEET

TABLE C-3. AIRFLOW, LOWEST--BALTIMORE MARYLAND

Date: 5/21/79 Baro. press: 29.75 in Hg Baro. press: 29.90 in Hg	Point	Traverse location (cm)	Total pressure Inlet Δ_h (in H_2O)	Total pressure Outlet Δ_h (in H_2O)	Pressure drop (in H_2O)	Velocity press. inlet Δ_{hi} (in H_2O)	$\sqrt{\Delta_{hi}}$	Air density α_A (lb/ft^3)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m^2)	Airflow rate (m^3/min)	Airflow rate (Mg/hr)
East fan	1		-18.33	-5.00		1.20	1.10						
Vel. { T_D = 21.4°C (70.5°F)	2		-17.78	-4.80		1.75	1.32						
T_W = 18.3°C (65.0°F)	3		-17.78	-4.50		1.90	1.38						
Press. { T_D = 17.2°C (63.0°F)	4		-16.96	-4.20		2.00	1.41						
T_W = 15.0°C (59.0°F)	5		-16.42	-4.50		2.10	1.45						
	6		-15.87	-4.50		2.00	1.41						
	7		-16.42	-4.60		1.90	1.38						
	8		-16.42	-4.80		1.60	1.26						
Average			-17.00	-4.61	12.39		1.34	0.07488	5,370	1,637	0.456	746.6	53.72
West fan	1		-16.42	-4.50		1.80	1.34						
Vel. { T_D = 21.4°C (70.5°F)	2		-16.42	-4.30		2.50	1.58						
T_W = 18.3°C (65.0°F)	3		-16.42	-4.00		2.70	1.64						
Press. { T_D = 17.2°C (63.0°F)	4		-15.87	-4.00		2.70	1.64						
T_W = 15.3°C (59.5°F)	5		-16.42	-4.20		2.80	1.67						
	6		-17.51	-4.20		2.80	1.67						
	7		-17.51	-4.50		2.40	1.55						
	8		-17.24	-4.70		2.00	1.41						
Average			-16.73	-4.30	12.43		1.56	0.07488	6,252	1,906	0.456	869.1	62.27
Jet fan	1	1.27	0	30.10		3.80	1.95						
T_D = 30°C (86.0°F)	2	5.08	0	30.10		3.40	1.84						
T_W = 21°C (70.0°F)	3	15.24	0	30.10		2.95	1.72						
	4	19.05	0	30.10		2.75	1.66						
Average				30.10	30.10		1.79	0.07488	7,174	2,187	0.0324	70.85	5.10

TABLE C-4. AIRFLOW, MIDDLE--BALTIMORE , MARYLAND

Date: 5/23/79 Bar. press.: 29.80 in Hg	Point	Traverse location (cm)	Total pressure		Pressure drop (in H_2O)	Velocity press. inlet Δ_{hi} (in H_2O)	$\sqrt{\Delta_{hi}}$	Air density ϱ_A (lb/ft^3)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m^2)	Airflow rate (m^3/min)	Airflow rate (Mg/h)
			Inlet Δ_h (in H_2O)	Outlet Δ_h (in H_2O)									
East fan	1		-14.23	-2.10		1.80	1.34						
Vel. { T_D = 22.8°C (73.0°F)	2		-13.68	-2.00		2.70	1.64						
T_W = 21.1°C (70.0°F)	3		-13.68	-1.55		3.10	1.76						
Press. { T_D = 26.1°C (79.0°F)	4		-13.68	-1.58		3.30	1.82						
T_W = 21.1°C (70.0°F)	5		-13.41	-1.58		3.40	1.84						
	6		-13.41	-1.65		2.80	1.67						
	7		-13.41	-1.70		2.60	1.61						
	8		-13.13	-2.10		2.40	1.55						
Average			-13.59	-1.78	11.81		1.65	0.07454	6,465	1,970	0.456	898.32	64.38
West fan	1		-13.41	-2.10		2.20	1.48						
Vel. { T_D = 22.8°C (73.0°F)	2		-13.41	-1.75		3.00	1.73						
T_W = 21.1°C (70.0°F)	3		-13.68	-1.58		3.50	1.87						
Press. { T_D = 26.1°C (79.0°F)	4		-13.68	-2.80		3.40	1.84						
T_W = 21.1°C (70.0°F)	5		-13.68	-3.20		2.90	1.70						
	6		-15.05	-3.60		2.70	1.64						
	7		-15.32	-3.50		2.60	1.61						
	8		-15.05	-3.40		2.40	1.55						
Average			-14.16	-2.74	11.42		1.68	0.07454	6,748	2,057	0.456	937.99	67.19
Jet fan	1	1.27	0	28.73		3.80	1.95						
T_D = 33.6°C (92.5°F)	2	5.08	0	28.73		3.40	1.84						
T_W = 24.4°C (76.0°F)	3	15.24	0	28.73		2.80	1.67						
	4	19.05	0	28.73		2.90	1.70						
Average					28.73		1.79	0.07189	7,322	2,232	0.0324	72.30	5.00

TYPING GUIDE SHEET

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TABLE C-5. AIRFLOW, HIGHEST--BALTIMORE MARYLAND

Date: 5/22/79 Baro. press: 29.90 in Hg	Point	Traverse location (cm)	Total pressure Inlet Δ_h (in H_2O)	Total pressure Outlet Δ_h (in H_2O)	Pressure drop (in H_2O)	Velocity press. inlet Δ_{hi} (in H_2O)	$\sqrt{\Delta_{hi}}$	Air density ω_A (lb/ft^3)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m^2)	Airflow rate (m^3/min)	Airflow rate (Mg/h)
East fan	1		-9.58	-0.24		3.30	1.82						
Vel. Press. T_D = 23.4°C (74.3°F)	2		-8.76	-0.77		4.50	2.12						
T_W = 17.8°C (64.0°F)	3		-8.76	-0.97		4.90	2.21						
	4		-8.76	-0.96		4.25	2.06						
	5		-10.12	-0.66		4.20	2.05						
	6		-10.67	-0.69		4.40	2.10						
	7		-10.67	-0.43		4.50	2.12						
	8		-5.34	-0.00		4.00	2.00						
Average			-9.08	-0.59	8.49		2.06	0.07440	8,282	2,525	0.456	1151.4	82.32
West fan	1		-10.94	-0.60		2.70	1.64						
Vel. Press. T_D = 23.4°C (73.4°F)	2		-10.94	-1.10		3.90	1.97						
T_W = 17.8°C (64.0°F)	3		-10.94	-1.20		4.30	2.07						
	4		-10.94	-1.20		4.20	2.05						
	5		-9.58	-0.85		4.25	2.06						
	6		-9.03	-0.85		3.60	1.90						
	7		-9.03	-0.65		3.65	1.91						
	8		-9.03	-0.15		3.55	1.88						
Average			-10.05	-0.83	9.23		1.94	0.07440	7,800	2,377	0.456	1083.91	77.53
Jet fan	1	1.27	0	30.10		3.80	1.95						
T_D = 30.0°C (86°F)	2	5.08	0	31.46		3.50	1.87						
T_W = 22.8°C (73°F)	3	15.24	0	31.46		3.05	1.75						
	4	19.05	0	31.46		2.95	1.72						
Average				31.12	31.12		1.82	0.07552	7,263	2,214	0.0324	71.73	5.21

TYPING GUIDE SHEET

TABLE C-6. PARTICLE SIZE DISTRIBUTION--BALTIMORE, MARYLAND

Run No.	Screen size (cm)	Lights: Total weight (g)	Lights: % Retained	Lights: Cumulative % passing	Heavies: Total weight (g)	Heavies: % Retained	Heavies: Cumulative % passing
1	+10.16	222.24	9.5	90.5	130.19	3.4	96.6
	+ 5.08	297.38	12.7	77.8	1,292.57	34.2	62.4
	+ 2.54	511.34	21.8	56.0	557.58	14.7	47.7
	+ 1.59	134.32	5.7	50.3	340.36	9.0	38.7
	+ 0.95	169.97	7.3	43.0	443.44	11.7	27.0
	- 0.95	1,006.16	43.0		1,019.25	27.0	
	Total	2,341.41			3,783.39		
2	+10.16	0	0	100	51.56	8.3	91.7
	+ 5.08	95.17	8.0	92.0	77.64	12.4	79.3
	+ 2.54	227.04	19.1	72.9	68.95	11.1	68.2
	+ 1.59	76.09	6.4	66.5	34.03	5.5	62.7
	+ 0.95	154.16	12.9	53.6	76.88	12.3	50.4
	- 0.95	638.18	53.6		314.72	50.4	
	Total	1,190.64			623.78		
3	+10.16	203.27	12.8	87.2	0	0	100
	+ 5.08	311.19	19.6	67.6	26.90	7.0	93.0
	+ 2.54	230.28	14.5	53.1	56.01	14.6	78.4
	+ 1.59	62.88	4.0	49.1	62.79	16.4	62.0
	+ 0.95	93.95	5.9	43.2	51.59	13.4	48.6
	- 0.95	683.14	43.2		186.57	48.6	
	Total	1,584.71			383.86		
6	+10.16	0	0	100	271.31	7.2	92.8
	+ 5.08	187.76	7.6	92.4	894.56	23.7	69.1
	+ 2.54	476.84	19.4	73.0	1,280.31	33.9	35.2
	+ 1.59	183.24	7.5	65.5	244.87	6.5	28.7
	+ 0.95	378.33	15.4	50.1	291.91	7.7	21.0
	- 0.95	1,232.79	50.1		790.85	21.0	
	Total	2,458.96			3,773.81		

(continued)

TYPING GUIDE SHEET

TABLE C-6. (continued)

Run No.	Screen size (cm)	Lights			Heavies		
		Total weight (g)	% Retained	Cumulative % passing	Total weight (g)	% Retained	Cumulative % passing
9	+10.16	53.45	1.7	98.3	91.58	2.6	97.4
	+ 5.08	99.91	3.3	95.0	202.75	5.7	91.7
	+ 2.54	472.92	15.5	79.5	620.09	17.4	74.3
	+ 1.59	209.80	6.9	72.6	350.21	9.8	64.5
	+ 0.95	397.06	13.0	59.6	443.63	12.4	52.1
	- 0.95	1,826.57	59.6		1,864.33	52.1	
	Total	3,059.71			3,572.59		
10	+10.16	0	0	100	19.28	0.5	99.5
	+ 5.08	238.78	6.3	93.7	395.29	10.3	89.2
	+ 2.54	574.34	15.2	78.5	814.17	21.2	68.0
	+ 1.59	264.72	7.0	71.5	529.94	13.8	54.2
	+ 0.95	524.29	13.9	57.6	445.12	11.6	42.6
	- 0.95	2,177.63	57.6		1,642.42	42.6	
	Total	3,779.76			3,845.77		
11	+10.16	52.55	0.9	99.1	65.68	1.5	98.5
	+ 5.08	364.39	6.5	92.6	1,003.98	23.2	75.3
	+ 2.54	655.71	11.8	80.8	691.15	16.0	59.3
	+ 1.59	369.16	6.6	74.2	287.00	6.6	52.7
	+ 0.95	782.56	14.1	60.1	376.91	8.7	44.0
	- 0.95	3,342.51	60.1		1,904.84	44.0	
	Total	5,566.88			4,329.56		
12	+10.16	62.02	1.9	98.1	0	0	100
	+ 5.08	150.60	4.6	93.5	476.10	15.1	84.9
	+ 2.54	464.15	14.0	79.5	505.63	16.0	68.9
	+ 1.59	190.01	5.8	73.7	412.49	13.0	55.9
	+ 0.95	358.64	10.9	62.8	452.07	14.3	41.6
	- 0.95	2,078.95	62.8		1,314.59	41.6	
	Total	3,304.35			3,160.88		

(continued)

TABLE C-6. (continued)

Run No.	Screen size (cm)	Lights Total weight (g)	Lights % Retained	Lights Cumulative % passing	Heavies Total weight (g)	Heavies % Retained	Heavies Cumulative % passing
14	+10.14	0	0	100	0	0	100
	+ 5.08	103.10	3.6	96.4	66.46	4.9	95.1
	+ 2.54	488.16	17.3	79.1	212.72	15.5	79.6
	+ 1.59	148.16	5.2	73.9	144.05	10.5	69.1
	+ 0.95	307.01	10.9	63.0	276.12	20.2	48.9
	- 0.95	1,780.68	63.0		669.25	48.9	
	Total	2,827.11			1,368.60		
15	+10.16	100.54	2.4	97.6	0	0	100
	+ 5.08	230.95	5.5	92.1	1,000.39	22.4	77.6
	+ 2.54	691.21	16.6	75.5	896.54	20.1	57.5
	+ 1.59	453.63	10.9	64.6	350.21	7.8	49.7
	+ 0.95	664.89	15.9	48.7	577.81	12.9	36.8
	- 0.95	2,030.01	48.7		1,645.53	36.8	
	Total	4,171.23			4,470.48		
23	+10.16	56.04	2.3	97.7	362.51	11.2	88.8
	+ 5.08	231.20	9.4	88.3	713.95	22.1	66.7
	+ 2.54	481.23	17.0	71.3	807.47	25.0	41.7
	+ 1.59	132.89	5.4	65.9	229.96	7.1	34.6
	+ 0.95	301.02	12.3	53.6	214.95	6.6	28.0
	- 0.95	1,314.26	53.6		907.36	28.0	
	Total	2,453.64			3,236.20		
25	+10.16	67.18	3.2	96.8	157.63	4.2	95.8
	+ 5.08	310.81	15.0	81.8	543.38	14.4	81.4
	+ 2.54	458.23	22.1	59.7	1,099.82	29.1	52.3
	+ 1.59	198.72	9.6	50.1	346.65	9.2	43.1
	+ 0.95	212.98	10.3	39.8	352.58	9.3	33.8
	- 0.95	824.33	39.8		1,284.38	33.8	
	Total	2,072.25			3,784.44		

(continued)

TABLE C-6. (concluded)

Run No.	Sheave sites air setting (m^3/min)	Screen size (cm)	Lights: Paper and plastic weight (g)	Lights: Aluminum weight (g)	Lights: Ferrous weight (g)	Lights: Other weight (g)	Lights: Total weight (g)	Lights: 14 Mesh grit (g)	Heavies: Paper and plastic weight (g)	Heavies: Aluminum weight (g)	Heavies: Ferrous weight (g)	Heavies: Other weight (g)	Heavies: Total weight (g)	Heavies: 14 Mesh grit (g)
27	1908.61	+10.16	0	0	0	0	0		102.90	0	0	0	102.90	
		+ 5.08	183.81	0	0	1.63	185.44		243.41	12.51	210.92	27.39	493.87	
		+ 2.54	330.70	0	0	17.44	348.14		476.10	1.47	39.46	146.51	663.54	
		+ 1.59	161.83	0	3.77	8.92	174.52		187.97	10.12	0	164.51	362.60	
		+ 0.95	197.90	0	0	15.90	213.80		247.58	0	9.35	70.06	326.99	
		- 0.95	335.67	0	0	283.59	619.26		503.13	0	0	390.50	893.63	
		Total	1,209.91	0	3.77	327.48	1,541.16	209.34	1,761.09	23.74	259.73	798.97	2,843.53	207.37
28	1908.61	+10.16	0	0	0	0	0		0	0	5.70	24.00	29.70	
		+ 5.08	43.77	0	0	0	43.77		151.24	0	255.88	81.68	488.80	
		+ 2.54	211.18	0	0	34.75	245.93		335.88	9.41	118.64	142.38	606.31	
		+ 1.59	125.31	1.46	0	13.41	140.18		226.36	3.13	0	66.02	295.51	
		+ 0.95	250.29	0	0	23.56	273.85		314.01	1.24	0	126.77	442.02	
		- 0.95	563.22	0	0	363.80	927.02		521.81	0	0	649.07	1,170.88	
		Total	1,193.77	1.46	0	435.52	1,630.75a/	320.59	1,549.30	13.78	380.22	1,089.93	3,033.22b/	319.28
29	1908.61	+10.16	0	0	0	0	0		138.82	0	0	0	138.82	
		+ 5.08	104.72	0	0	1.14	105.86		46.46	0	129.47	1,236.82	1,412.75	
		+ 2.54	187.75	0	0	8.22	195.97		195.54	22.65	24.31	123.98	366.48	
		+ 1.59	116.22	1.63	0	2.74	120.59		104.25	1.24	0	59.56	165.05	
		+ 0.95	196.40	0	0	19.29	215.69		178.50	7.09	73.75	93.14	352.48	
		- 0.95	305.21	0	0	420.83	726.04		375.86	0	0	505.63	881.49	
		Total	910.30	1.63	0	452.22	1,364.15	237.89	1,039.43	30.98	227.53	2,019.13	3,317.07	176.87
30	1908.61	+10.16	26.62	0	0	0	26.62		0	0	0	0	0	
		+ 5.08	69.01	0	0	0	69.01		1.59	0	87.76	57.94	147.29	
		+ 2.54	381.02	0	0	35.70	416.72		81.00	129.71	140.46	288.84	640.01	
		+ 1.59	190.66	0	0	11.17	201.83		13.11	8.78	52.79	230.85	305.53	
		+ 0.95	381.78	0	0	13.52	395.30		18.86	5.59	55.46	341.04	420.95	
		- 0.95	615.52	0	0	653.19	1,268.71		29.88	0	20.73	1,305.48	1,356.09	
		Total	1,664.61	0	0	713.58	2,378.19	379.48	144.44	144.08	357.20	2,224.15	2,869.87	38.21

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a/ This number reads "1,756.38: on data sheet.

b/ This number reads "1,633.75: on data sheet; apparently the "245.93" in the total weight column was incorrectly read as "248.93."

c/ This number reads "3,033.23" on data sheet.

EPA Form 2230-4 (4-80)
(PREVIOUSLY CIN. EPA FORM 261)
TYPING GUIDE SHEET

TABLE C-7. SAMPLE COMPOSITION--BALTIMORE, MARYLAND

Run No.	Sheave sites air setting (m^3/min)	Screen size (cm)	Lights						Heavies					
			Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh grit (g)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh grit (g)
1	1686.45	+10.16	222.24	0	0	0	222.24		98.26	0	0	31.93	130.19	
		+ 5.08	244.07	20.98	0	32.33	297.38		224.60	261.05	722.18	84.74	1,292.57	
		+ 2.54	425.60	0	0	85.74	511.34		187.61	92.90	48.69	228.38	557.58	
		+ 1.59	120.98	0	1.55	11.79	134.32		59.25	4.67	38.51	237.93	340.36	
		+ 0.95	132.66	0.90	0	36.41	169.97		45.54	5.04	97.96	294.90	443.44	
		- 0.95	147.96	0	0	858.20	1,006.16		54.34	1.13	0	963.78	1,019.25	
		Total	1,293.51	21.88	1.55	1,024.47	2,341.41	425.84	669.60	364.79	907.34	1,841.66	3,783.39	104.21
2	1686.45	+10.16	0	0	0	0	0		47.28	0	0	4.28	51.56	
		+ 5.08	95.17	0	0	0	95.17		37.24	40.40	0	0	77.64	
		+ 2.54	213.42	0	0	13.62	227.04		28.34	24.34	0	16.27	68.95	
		+ 1.59	74.36	0	0	1.73	76.09		5.83	1.71	0	26.49	34.03	
		+ 0.95	147.50	1.23	0	5.43	154.16		11.62	0.64	0	64.62	76.88	
		- 0.95	262.73	0	0	375.45	638.18		28.69	0	0	286.03	314.72	
		Total	793.18	1.23	0	396.23	1,190.64	227.90	159.00	67.09	0	397.69	623.78	48.33
3	1686.45	+10.16	203.27	0	0	0	203.27		0	0	0	0	0	
		+ 5.08	308.04	0	0	3.15	311.19		26.90	0	0	0	26.90	
		+ 2.54	224.72	4.40	0	1.16	230.28		0.41	1.59	0	54.01	56.01	
		+ 1.59	49.52	0	0	13.36	62.88		0.47	0	5.00	57.32	62.79	
		+ 0.95	74.23	0	0	19.72	93.95		0.04	0	0	51.55	51.59	
		- 0.95	79.51	0	0	603.63	683.14		1.22	0	0	185.35	186.57	
		Total	939.29	4.40	0	641.02	1,584.71	327.08	29.04	1.59	5.00	348.23	383.86	8.80
6	1686.45	+10.16	0	0	0	0	0		77.61	0	0	193.70	271.31	
		+ 5.08	168.32	0	0	19.44	187.76		238.85	22.05	444.78	188.88	894.56	
		+ 2.54	468.01	0	0	8.83	476.84		502.46	224.14	318.12	235.59	1,280.31	
		+ 1.59	169.02	0	0	14.22	183.24		159.38	6.40	0	79.09	244.87	
		+ 0.95	334.71	1.96	0	41.66	378.33		216.72	2.09	2.19	70.91	291.91	
		- 0.95	763.93	0	0	468.86	1,232.79		437.60	0	0	352.25	790.85	
		Total	1,903.99	1.96	0	553.01	2,458.96	439.50	1,632.62	254.68	765.09	1,121.42	3,773.81	243.49

(continued)

TYPING GUIDE SHEET

TABLE C-7. (continued)

			Lights						Heavies					
Run No.	Sheave sites air setting (m^3/min)	Screen size (cm)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh grit (g)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh grit (g)
9	1686.45	+10.16	53.45	0	0	0	53.45		61.68	0	0	29.90	91.58	
		+ 5.08	99.61	0	0	0.30	99.91		146.56	0	51.49	4.70	202.75	
		+ 2.54	452.17	8.56	0	12.19	472.92		403.39	25.06	9.12	182.52	620.09	
		+ 1.59	184.25	0	0	25.55	209.80		165.44	33.20	38.76	112.81	350.21	
		+ 0.95	362.04	3.65	0	31.37	397.06		224.43	5.23	0	213.97	443.63	
		- 0.95	420.93	0	0	1,405.64	1,826.57		633.77	0	0	1,230.56	1,864.33	
		Total	1,572.45	12.21	0	1,475.05	3,059.71	743.34	1,635.27	63.49	99.37	1,774.46	3,572.59	305.68
10	2307.04	+10.16	0	0	0	0	0		19.28	0	0	0	19.28	
		+ 5.08	183.21	0	39.73	15.84	238.78		116.43	0	168.47	110.39	395.29	
		+ 2.54	544.09	5.15	0.76	24.34	574.34		380.89	30.28	263.20	139.80	814.17	
		+ 1.59	262.41	0	0	2.31	264.72		171.94	102.34	110.95	144.26	529.49	
		+ 0.95	453.27	4.38	5.30	61.34	524.29		251.24	1.97	0	191.91	445.12	
		- 0.95	446.75	0	0	1,730.88	2,177.63		289.89	19.39	0	1,333.14	1,642.42	
		Total	1,889.73	9.53	45.79	1,834.71	3,779.76	767.03	1,229.67	153.98	542.62	1,919.50	3,845.77	291.90
11	2307.04	+10.16	52.55	0	0	0	52.55		65.68	0	0	0	65.68	
		+ 5.08	347.75	0	0	16.64	364.39		256.08	17.18	730.70	0.02	1,003.98	
		+ 2.54	624.38	5.69	0	25.64	655.71		391.42	47.97	155.30	96.46	691.15	
		+ 1.59	358.11	0	0	11.05	369.16		181.08	8.79	31.58	65.55	287.00	
		+ 0.95	743.12	0	0	39.44	782.56		196.50	1.38	20.30	158.73	376.91	
		- 0.95	1,414.55	0	0	1,927.96	3,342.51		347.45	0	0	1,557.39	1,904.84	
		Total	3,540.45	6.69	0	2,020.73	5,566.88	1,287.35	1,438.21	75.32	937.88	1,878.15	4,329.56	469.57
12	2307.04	+10.16	62.02	0	0	0	62.02		0	0	0	0	0	
		+ 5.08	148.20	0	0	2.40	150.60		48.33	0	366.82	60.95	476.10	
		+ 2.54	436.47	1.56	0	26.12	464.15		76.66	32.18	178.29	218.50	505.63	
		+ 1.59	163.05	7.15	10.14	9.67	190.01		19.08	6.77	118.80	267.84	412.49	
		+ 0.95	322.54	5.20	0	30.90	358.62		53.85	0.26	67.14	330.82	452.07	
		- 0.95	924.10	0	0	1,154.85	2,078.95		73.86	0.61	17.02	1,223.10	1,314.59	
		Total	2,056.38[a]	13.91	10.14	1,223.94	3,304.35	861.55	271.78	39.82	748.07	2,101.21	3,160.88	68.27

(continued)

TABLE C-7. (continued)

Run No.	Sheave sites air setting (m^3/min)	Screen size (cm)	Lights: Paper and plastic weight (g)	Lights: Aluminum weight (g)	Lights: Ferrous weight (g)	Lights: Other weight (g)	Lights: Total weight (g)	Lights: 14 Mesh grit (g)	Heavies: Paper and plastic weight (g)	Heavies: Aluminum weight (g)	Heavies: Ferrous weight (g)	Heavies: Other weight (g)	Heavies: Total weight (g)	Heavies: 14 Mesh grit (g)
14	2307.04	+10.16	0	0	0	0	0		0	0	0		0	
		+ 5.08	97.02	0	0	6.08	103.10		0	7.74	58.72	0	66.46	
		+ 2.54	435.46	3.56	0	49.14	488.16		25.65	16.64	47.33	123.10	212.72	
		+ 1.59	142.27	0	0	5.79	148.16		7.29	0	10.48	126.28	144.05	
		+ 0.95	281.22	1.48	0	24.31	307.01		19.00	0	29.52	227.60	276.12	
		- 0.95	725.00	0	0	1,055.68	1,780.68		30.04	0	4.35	634.86	669.25	
		Total	1,681.07	5.04	0	1,141.00	2,827.11	907.17	81.98	24.38	150.40	1,111.84	1,368.60	162.34
15	2307.04	+10.16	70.82	0	0	29.72	100.54		0	0	0	0	0	
		+ 5.08	144.20	0	0	86.75	230.95		120.74	0	814.44	65.21	1,000.39	
		+ 2.54	550.35	18.77	35.29	86.80	691.21		239.93	5.01	408.72	242.68	896.54	
		+ 1.59	446.09	0	0	7.54	453.63		99.42	9.97	118.26	122.56	350.21	
		+ 0.95	571.51	0	0	93.38	664.89		179.89	3.88	42.14	351.90	577.81	
		- 0.95	1,100.00	0	0	930.01	2,030.01		367.48	0	0	1,278.05	1,645.53	
		Total	2,882.97	18.77	35.29	1,234.20	4,171.23	588.82	1,007.46	18.86	1,383.56	2,060.60	4,470.48	113.64
23	1908.61	+10.16	56.04	0	0	0	56.04		233.37	0	93.07	35.17	362.51	
		+ 5.08	190.59	0	40.61	0	231.20		134.46	20.26	555.07	4.16	713.95	
		+ 2.54	405.87	10.63	0	1.73	418.23		181.56	60.18	487.42	78.31	807.47	
		+ 1.59	128.97	0	0	3.92	132.89		59.16	70.79	34.82	65.19	229.96	
		+ 0.95	286.76	1.26	0	13.00	301.02		76.07	0.94	20.90	117.04	214.95	
		- 0.95	604.35	0	0	709.91	1,314.26		122.02	2.87	0	782.47	907.36	
		Total	1,672.58	11.89	40.61	728.56	2,453.64	566.30	806.64	155.04	1,192.18	1,082.34	3,236.20	210.04
25	1908.61	+10.16	67.18	0	0	0	67.18		85.54	0	0	72.09	157.63	
		+ 5.08	310.81	0	0	0	310.81		301.99	20.24	200.35	20.80	543.38	
		+ 2.54	442.86	3.46	2.57	9.34	458.23		414.07	16.63	336.76	332.36	1,099.82	
		+ 1.59	192.32	2.65	0	3.75	198.72		199.12	2.82	5.45	139.26	346.65	
		+ 0.95	193.38	0	0	19.60	212.98		221.15	4.98	1.54	124.91	352.58	
		- 0.95	200.90	0	0	623.43	824.33		120.13	0	36.24	1,128.01	1,284.38	
		Total	1,407.45	6.11	2.57	656.12	2,072.25	360.93	1,342.00	44.67	580.34	1,817.43	3,784.44	342.41

(continued)

TABLE C-7. (concluded)

		Lights			Heavies		
Run No.	Screen size (cm)	Total weight (g)	% Retained	Cumulative % passing	Total weight (g)	% Retained	Cumulative % passing
27	+10.16	0	0	100	102.90	3.6	96.4
	+ 5.08	185.44	12.0	88.0	493.87	17.4	79.0
	+ 2.54	348.14	22.6	65.4	663.54	23.3	55.7
	+ 1.59	174.52	11.3	54.1	362.60	12.8	42.9
	+ 0.95	213.80	13.9	40.2	326.99	11.5	31.4
	- 0.95	619.26	40.2		893.63	31.4	
	Total	1,541.16			2,843.53		
28	+10.16	0	0	100	29.70	1.0	99.0
	+ 5.08	43.77	2.7	97.3	488.80	16.1	82.9
	+ 2.54	245.93[a]	15.1	82.2	606.31	20.0	62.9
	+ 1.59	140.18	8.6	73.6	295.51	9.7	53.2
	+ 0.95	273.85	16.8	56.8	442.02	14.6	38.6
	- 0.95	927.02	56.8		1,170.88	38.6	
	Total	1,630.75			3,033.23		
29	+10.16	0	0	100	138.82	4.2	95.8
	+ 5.08	105.86	7.8	92.2	1,412.75	42.6	53.2
	+ 2.54	195.97	14.4	77.8	366.48	11.0	42.2
	+ 1.59	120.59	8.8	69.0	165.05	5.0	37.2
	+ 0.95	215.69	15.8	53.2	352.48	10.6	26.6
	- 0.95	726.04	53.2		881.49	26.6	
	Total	1,364.15			3,317.07		
30	+10.16	26.62	1.1	98.9	0	0	100
	+ 5.08	69.01	2.9	96.0	147.29	5.1	94.9
	+ 2.54	416.72	17.5	78.5	640.01	22.3	72.6
	+ 1.59	201.83	8.5	70.0	305.53	10.6	62.0
	+ 0.95	395.30	16.6	53.4	420.95	14.7	47.3
	- 0.95	1,268.71	53.4		1,356.09	47.3	
	Total	2,378.19			2,869.87		

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[a] This number was apparently misread as "248.93" by the person filling out the data sheets; as a result there are corresponding corrections made here in the total of the total weights column; in the % retained; and in the last three entries in the cumulative % passing column.

TABLE C-8. MOISTURE CONTENT, INITIAL TO AIR DRIED CONDITION--BALTIMORE MARYLAND

	Lights				Heavies			
Run No.	Initial weight (g)	Final weight (g)	Moisture weight (g)	Moisture content (%)	Initial weight (g)	Final weight (g)	Moisture weight (g)	Moisture content (%)
1	3,239	2,358	881	27.2	4,517	3,807	710	15.7
2	1,648	1,222	426	25.8	739	625	114	15.4
3	2,614	1,619	995	38.1	511	426	85	16.6
6	3,267	2,443	824	25.2	4,517	3,778	739	16.4
9	4,432	3,068	1,364	30.8	4,915	3,608	1,307	26.6
10	5,511	3,835	1,676	30.4	4,830	3,864	966	20.0
11	7,500	5,596	904	25.4	5,284	4,347	937	17.7
12	4,943	3,292	1,651	33.4	3,807	3,178	629	16.5
14	4,261	2,898	1,363	32.0	1,563	1,420	143	9.1
15	6,278	4,228	2,050	32.7	5,398	4,512	886	16.4
23	3,239	2,472	767	23.7	5,938	3,267	2,671	45.0
25	3,239	2,102	1,137	35.1	5,284	3,892	1,392	26.3
27	2,244	1,561	683	30.5	4,034	2,838	1,196	29.7
28	2,244	1,646	598	26.7	3,920	3,065	855	21.8
29	1,932	1,392	540	28.0	3,920	3,352	668	14.5
30	3,295	2,386	909	27.6	3,523	2,898	625	17.7

Sample calculation: $\frac{\text{Initial Wt.} - \text{Air Dried Wt.}}{\text{Initial Wt.}} \times 100 = \%\ \text{Moisture Content}$

For Run 1 lights: $\frac{3{,}239 - 2{,}358}{3{,}239} \times 100 = 27.2\%$

TABLE C-9. POWER MEASUREMENTS--BALTIMORE MARYLAND

Fan setting	Fan No. 1 (kW)	Fan No. 2 (kW)	Cone air fan (kW)	Baghouse (kW)	East air lock (kW)	West air lock (kW)	Total (kW)
1	72.8	83.0	16.3	141.3	0.8	0.8	315.0
2	92.5	101.0	16.7	144.0	0.8	0.8	355.8
3	83.0	86.0	16.6	138.0	0.8	0.8	325.2

APPENDIX D

FIELD TEST DATA FOR VERTICAL RECTANGULAR AIR CLASSIFIER--RICHMOND, CALIFORNIA

TABLE D-1. SUMMARY OF OPERATIONAL DATA--RICHMOND, CALIFORNIA

Run No.	Input feed rate (Mg/h)	Lights feed rate (Mg/h)	Split percent lights	Air setting (m^3/min)	Ash percent in lights	Ash percent in heavies	Paper + plastic percent in lights	Lights[a] percent moisture content	Paper + plastic percent in heavies	Higher heating Value,[b] kJ/kg Lights	Higher heating Value,[b] kJ/kg Heavies
1	0.62	0.51	82.19	154.07	14.9	70.10	2.25	18.1	91.3	11,581	1,658
2	0.57	0.46	81.38	154.07	21.0	62.42	2.80	16.8	85.7	15,286	1,368
3	2.37	2.06	87.00	154.07	25.9	54.91	7.67	28.9	76.6		
4	2.12	1.86	87.61	154.07	21.0	67.86	12.59	21.0	65.1		
5	4.92	3.90	79.18	154.07	26.6	59.27	21.34	27.6	45.8		
6	7.83	3.43	43.87	154.07							
7	5.43	2.49	45.77	154.07							
8	0.67	0.56	83.90	102.19	2.0	74.71	10.12	11.5	84.6		
9	1.47	1.03	69.75	102.19	14.2	61.64	19.65	25.4	76.0	14,233	5,182
10	0.82	0.64	78.62	102.19	9.1	46.65	10.79	25.6	73.0		
11	0.43	0.35	82.17	102.19	11.8	41.78	7.36	18.3	76.8	9,855	5,024
12	4.01	2.44	60.92	102.19	4.0	51.34	29.53	24.6	73.5		
13	5.67	3.35	59.05	102.19	8.3	59.85	47.24	24.4	38.5	13,584	12,144
14	0.12	0.10	81.03	102.19	5.4	73.76	14.20	14.8	89.1	15,005	4,619
15	0.93	0.47	51.13	78.66	17.7	70.51	35.55	19.1	48.5		
16	0.35	0.22	63.84	78.66	15.3	80.65	28.76	13.9	60.0	16,770	8,043
17	0.13	0.08	60.37	78.66	12.9	77.43	19.74	15.0	57.0	8,074	11,811
18	1.57	1.00	63.27	78.66	14.2	78.63	57.25	17.0	39.5		
19	6.22	1.64	26.35	78.66	18.4	54.58	51.64	21.4	43.4		
20	4.96	1.17	23.67	78.66							
21	2.43	0.86	35.37	78.66	16.7	70.32	40.23	16.01	48.9		

[a] From initial to air-dried condition.

[b] Oven dried basis.

TABLE D-2. FEED RATES--RICHMOND, CALIFORNIA

Date 1979	Airflow setting	Run No.	Lights					Heavies					Input
			Sample weight (kg)	Tare weight (kg)	Balance weight (kg)	Time (sec)	Feed rate (Mg/h)	Sample weight (kg)	Tare weight (kg)	Balance weight (kg)	Time (sec)	Feed rate (Mg/hr)	Feed rate (Mg/h)
6-18		1	21.17	6.24	14.93	105.00	0.51	11.26	8.03	3.23	105.00	0.11	0.62
6-18		2	22.36	6.24	16.12	126.00	0.46	11.72	8.03	3.69	126.00	0.11	0.57
6-18		3	66.11	12.77	53.35	93.00	2.06	16.00	8.03	7.97	93.00	0.31	2.37
6-18	154.07 m^3/min	4	66.45	12.77	53.69	103.8	1.86	15.55	8.03	7.52	103.00	0.26	2.12
6-18	High Air Flow	5	82.51	20.80	61.72	57.00	3.90	24.26	8.03	16.23	57.00	1.03	4.92
6-18		6	64.18	12.77	51.42	53.90	3.43	81.75	15.98	65.77	53.90	4.39	7.83
6-18		7	46.88	12.77	34.11	49.40	2.49	56.38	15.98	40.41	49.40	2.94	5.43
6-19		8	28.29	12.77	15.52	100.00	0.56	11.01	8.03	2.98	100.00	0.11	0.67
6-19		9	41.03	12.77	28.26	99.00	1.03	20.29	8.03	12.26	99.00	0.45	1.47
6-19	102.19 m^3/min	10	22.42	6.55	15.86	89.00	0.64	12.26	7.95	4.31	89.00	0.17	0.82
6-19	Middle Air Flow	11	16.20	6.53	9.68	99.00	0.35	10.04	7.95	2.10	99.00	0.08	0.43
6-19		12	60.72	19.32	41.40	61.00	2.44	34.50	7.95	26.56	61.00	1.57	4.01
6-19		13	59.30	19.32	39.98	43.00	3.35	35.75	8.03	27.72	43.00	2.32	5.67
6-19		14	11.04	6.55	4.48	161.00	0.10	9.08	8.03	1.05	161.00	0.02	0.12
6-19		15	28.89	12.80	16.09	121.20	0.48	23.41	8.03	15.38	121.20	0.46	0.93
6-19		16	14.44	6.53	7.92	129.00	0.22	12.51	8.03	4.48	129.00	0.13	0.35
6-19		17	9.63	6.55	2.81	127.80	0.08	9.87	8.03	1.84	127.80	0.05	0.13
6-19	78.66 m^3/min	18	41.71	19.32	22.39	81.00	1.00	21.03	8.03	13.00	81.00	0.58	1.57
6-19	Low Air Flow	19	32.74	12.80	19.95	43.80	1.64	71.73	15.98	55.76	43.80	4.58	6.22
6-19		20	28.74	13.08	15.66	48.00	1.17	66.48	15.98	50.51	48.00	3.79	4.96
6-19		21	27.55	12.77	14.78	62.00	0.86	34.96	7.95	27.01	62.00	1.57	2.43

TABLE D-3. AIRFLOW, LOWEST--RICHMOND CALIFORNIA

Date: 6/20/79	Point	Traverse Location (cm)	Total Pressure		Pressure Drop Δh_t (in. H_2O)	Velocity Pressure Inlet Δh_t (in. H_2O)	$\sqrt{\Delta h_t}$	Air Density (lb/ft^3)	Air Velocity (ft/min)	Air Velocity (m/min)	Duct Area (m^2)	Airflow Rate (m^3/min)	Airflow Rate (Mg/h)
			Inlet Δh_t (in. H_2O)	Outlet Δh_t (in. H_2O)									
Fan Duct	0	0.79		- 0.46									
Baro. Press. =30.90 in.Hg	1	5.08	- 1.80	- 0.49		0.14	0.37						
Wet Bulb = 55°F	2	10.16	- 1.75	- 0.50		0.21	0.46						
Dry Bulb = 61°F	3	15.24	- 1.75	- 0.58		0.23	0.48						
	4	20.32	- 1.75	- 0.61		0.23	0.48						
	5	25.40	- 1.75	- 0.63		0.23	0.48						
	6	30.48	- 1.79	- 0.53		0.22	0.47						
	7	35.56	- 1.80	- 0.13		0.20	0.45						
	8	40.64	- 1.80	- 0.50		0.16	0.40						
	9	45.72		- 1.30									
	10	50.80		+ 2.50									
Average			- 1.77	+ 0.03	- 1.80		0.45						
Air Classifier	1	5.08				0.03	0.17						
Baro. Press. =30.90 in.Hg	2	10.16				0.03	0.17						
Wet Bulb = 55°F	3	15.24				0.03	0.17						
Dry Bulb = 61°F	4	20.32				0.03	0.17						
	5	25.40				0.03	0.17						
	6	30.48				0.03	0.17						
	7	35.56				0.03	0.17			201.68	0.39		
Average							0.17	0.07939	661.67			78.66	6.01

TABLE D-4. AIRFLOW, MIDDLE--RICHMOND , CALIFORNIA

Date: 6/19/79	Point	Traverse Location (cm)	Total Pressure		Pressure Drop Δh_1 (in. H_2O)	Velocity Pressure Inlet Δh_1 (in. H_2O)	$\sqrt{\Delta h_1}$	Air Density (lb/ft^3)	Air Velocity (ft/min)	Air Velocity (m/min)	Duct Area (m^2)	Airflow Rate (m^3/min)	Airflow Rate (Mg/h)
			Inlet Δh_1 (in. H_2O)	Outlet Δh_1 (in. H_2O)									
Fan Duct	0	0.79		- 0.61									
Baro. Press. = 31 in. Hg	1	5.08	- 4.10	- 0.71		0.31	0.56						
Wet Bulb = 55°F *	2	10.16	- 4.00	- 0.76		0.45	0.67						
Dry Bulb = 66°F	3	15.24	- 4.00	- 0.78		0.49	0.70						
	4	20.32	- 3.95	- 0.78		0.51	0.71						
	5	25.40	- 4.00	- 0.72		0.49	0.70						
	6	30.48	- 4.05	- 0.13		0.48	0.69						
	7	35.56	- 4.05	+ 1.20		0.43	0.66						
	8	40.64	- 4.10	+ 2.50		0.39	0.62						
	9	45.72		+ 4.00									
	10	50.80		+ 4.20									
Average			- 4.03	+ 0.67	4.70		0.66	0.07879					
Air Classifier	1	5.08				0.05	0.22						
Baro. Press. = 31 in. Hg	2	10.16				0.05	0.22						
Wet Bulb = 55°F *	3	15.24				0.05	0.22						
Dry Bulb = 66°F	4	20.32				0.05	0.22						
	5	25.40				0.05	0.22						
	6	30.48				0.05	0.22						
	7	35.56				0.05	0.22						
Average							0.22	0.07879	859.58	262.00	0.39	102.19	7.74

* Estimated.

TABLE D-5. AIRFLOW, HIGHEST--RICHMOND CALIFORNIA

			Total Pressure										
Date: 6/18/79	Point	Traverse Location (cm)	Inlet Δh_i (in. H_2O)	Outlet Δh_i (in. H_2O)	Pressure Drop Δh_i (in. H_2O)	Velocity Pressure Drop Δh_i (in. H_2O)	$\sqrt{\Delta h_i}$	Air Density (lb/ft^3)	Air Velocity (ft/min)	Air Velocity (m/min)	Duct Area (m2)	Airflow Rate (m^3/min)	Airflow Rate (Mg/h)
Fan Duct	0	0.79		- 0.93									
Baro. Press. = 31 in. Hg	1	5.08	- 8.00	- 0.95		0.61	0.78						
Wet Bulb = 56°F	2	10.16	- 7.75	- 0.97		0.87	0.93						
Dry Bulb = 63°F	3	15.24	- 7.60	- 1.10		0.99	0.99						
	4	20.32	- 7.65	- 1.20		1.00	1.00						
	5	25.40	- 7.70	- 1.25		0.97	0.98						
	6	30.48	- 7.70	- 1.30		0.93	0.96						
	7	35.56	- 7.80	- 1.32		0.87	0.93						
	8	40.64	- 7.85	- 1.40		0.72	0.85						
	9	45.72		- 1.40									
	10	50.80		- 1.20									
Average			- 7.76	- 1.18	6.58								
Air Classifier	1					0.11	0.33						
Baro. Press. = 31 in. Hg	2					0.11	0.33						
Wet Bulb = 61°F	3					0.11	0.33						
Dry Bulb = 72.5°F	4					0.11	0.33						
	5					0.12	0.35						
	6					0.11	0.33						
	7					0.09	0.30	0.07798	1,296.00	395.02	0.39	154.07	11.56
Average							0.33						

TABLE D-6. PARTICLE SIZE DISTRIBUTION--RICHMOND

CALIFORNIA

Run No.	Screen Size (cm)	Lights			Heavies		
		Total wt (g)	% Retained	Cumulative % Passing	Total wt (g)	% Retained	Cumulative % Passing
1	+10.16	0.00	0.0	100.0	0.00	0.0	100.0
	+ 5.08	32.45	2.8	97.2	93.26	3.1	96.9
	+ 2.54	338.99	28.9	68.3	575.97	18.9	78.0
	+ 1.59	353.81	30.1	38.2	508.80	16.7	61.3
	+ 0.95	216.30	18.4	19.8	498.20	16.1	45.2
	- 0.95	232.72	19.8		1,375.96	45.2	
	Total	1,174.27			3,043.19		
2	+10.16	0.00	0.0	100.0	0.00	0.0	100.0
	+ 5.08	30.93	1.8	98.2	20.11	0.6	99.4
	+ 2.54	411.72	24.4	73.8	710.27	21.3	78.1
	+ 1.59	303.46	18.0	55.8	562.54	16.8	61.3
	+ 0.95	316.77	18.8	37.0	586.69	17.6	43.7
	- 0.95	624.50	37.0		1,459.58	43.7	
	Total	1,687.38			3,339.19		
3	+10.16	0.00	0.0	100.0	0.00	0.0	100.0
	+ 5.08	15.44	0.9	99.1	224.39	3.4	96.6
	+ 2.54	242.78	13.7	85.4	1,431.65	21.8	74.8
	+ 1.59	316.29	17.9	67.5	901.89	13.7	61.1
	+ 0.95	316.32	17.9	49.6	1,078.20	16.4	44.7
	- 0.95	879.99	49.6		2,933.54	44.7	
	Total	1,770.82			6,569.67		
4	+10.16	0.00	0.0	100.0	0.00	0.0	100.0
	+ 5.08	17.29	0.9	99.1	12.40	0.2	99.8
	+ 2.54	391.98	20.7	78.4	1,504.05	23.4	76.4
	+ 1.59	429.52	22.7	55.7	1,533.86	23.9	52.5
	+ 0.95	344.71	18.2	37.5	1,423.53	22.2	30.3
	- 0.95	707.86	37.5		1,943.81	30.3	
	Total	1,891.36			6,417.65		
5	+10.16	0.00	0.00	100.00	0.00	0.00	100.00
	+ 5.08	9.07	0.58	99.42	16.21	0.57	99.43
	+ 2.54	299.74	19.10	80.32	565.86	19.78	79.65
	+ 1.59	160.98	10.26	70.06	616.63	21.56	58.09
	+ 0.95	269.63	17.18	52.88	646.31	22.59	35.35
	- 0.95	829.94	52.88		1,015.61	35.50	
	Total	1,569.36			2,860.62		
8	+10.16	0.00	0.0	100.0	0.00	0.0	100.0
	+ 5.08	63.39	4.5	95.5	142.27	5.1	94.9
	+ 2.54	403.63	28.7	66.8	1,030.37	36.8	58.1
	+ 1.59	375.93	26.7	40.1	485.94	17.4	40.7
	+ 0.95	178.97	12.7	27.4	414.37	14.8	25.9
	- 0.95	385.01	27.4		724.24	25.9	
	Total	1,406.93			2,797.19		
9	+10.16	0.00	0.0	100.0	0.00	0.0	100.0
	+ 5.08	24.47	1.7	98.3	42.60	1.1	98.9
	+ 2.54	168.78	11.9	86.4	701.66	18.8	80.1
	+ 1.59	232.96	16.5	69.9	593.89	16.0	64.1
	+ 0.95	273.12	19.3	50.6	627.18	16.8	47.3
	- 0.95	714.14	50.6		1,759.21	47.3	
	Total	1,413.47			3,724.54		
10	+10.16	0.00	0.0	100.0	0.00	0.0	100.0
	+ 5.08	14.65	1.1	98.9	59.64	1.6	98.4
	+ 2.54	246.10	17.6	81.3	966.84	25.3	73.1
	+ 1.59	166.52	11.9	69.4	480.02	12.5	60.6
	+ 0.95	256.81	18.4	51.0	583.84	15.3	45.3
	- 0.95	710.60	51.0		1,737.99	45.3	
	Total	1,394.68			3,828.33		
11	+10.16	0.00	0.0	100.0	0.00	0.0	100.0
	+ 5.08	0.00	0.0	100.0	33.39	1.7	98.3
	+ 2.54	189.03	14.6	85.4	304.16	15.9	82.4
	+ 1.59	110.04	8.5	76.9	219.77	11.5	70.9
	+ 0.95	210.93	16.3	60.6	267.73	14.0	56.9
	-0.95	787.94	60.6		1,092.41	56.9	
	Total	1,297.94			1,917.46		

(continued)

TABLE D-6. (concluded)

Run No.	Screen Size (cm)	Lights Total wt (g)	Lights % Retained	Lights Cumulative % Passing	Heavies Total wt (g)	Heavies % Retained	Heavies Cumulative % Passing
12	+10.16	0.00	0.0	100.0	0.00	0.0	100.0
	+ 5.08	2.48	0.2	99.8	39.37	1.4	98.6
	+ 2.54	173.65	13.0	86.8	592.62	21.4	77.2
	+ 1.59	240.35	18.0	68.8	551.08	19.9	57.3
	+ 0.95	253.78	19.0	49.8	380.37	13.7	43.6
	- 0.95	663.03	49.8		1,208.53	43.6	
	Total	1,333.29			2,771.97		
13	+10.16	0.00	0.0	100.0	0.00	0.0	100.0
	+ 5.08	4.51	0.4	99.6	13.34	0.7	99.3
	+ 2.54	150.78	12.0	87.6	210.05	11.5	87.8
	+ 1.59	210.50	16.8	70.8	332.97	18.3	69.5
	+ 0.95	258.22	20.6	50.2	345.53	19.0	50.5
	- 0.95	630.54	50.2		920.82	50.5	
	Total	1,254.55			1,822.71		
14	+10.16	0.00	0.0	100.0	0.00	0.0	100.0
	+ 5.08	0.00	0.0	100.0	0.00	0.0	100.0
	+ 2.54	285.45	28.1	71.9	291.31	30.7	69.3
	+ 1.59	251.54	24.8	47.1	173.00	18.3	51.0
	+ 0.95	207.50	20.4	26.7	147.69	15.6	35.4
	- 0.95	271.63	26.7		335.92	35.4	
	Total	1,016.12			947.92		
15	+10.16	0.00	0.0	100.0	0.00	0.0	100.0
	+ 5.08	0.00	0.0	100.0	0.00	0.0	100.0
	+ 2.54	140.95	17.7	82.3	149.39	9.8	90.2
	+ 1.59	176.70	22.2	60.1	369.83	24.3	65.9
	+ 0.95	179.35	22.6	37.5	270.56	17.8	48.1
	- 0.95	298.12	37.5		733.79	48.1	
	Total	795.12			1,523.57		
16	+10.16	0.00	0.0	100.0	0.00	0.0	100.0
	+ 5.08	6.31	1.0	99.0	0.00	0.0	100.0
	+ 2.54	135.04	22.0	77.0	384.07	17.9	82.1
	+ 1.59	136.64	22.2	54.8	277.04	12.9	69.2
	+ 0.95	131.43	21.4	33.4	372.79	17.4	51.8
	- 0.95	204.73	33.4		1,108.02	51.8	
	Total	614.15			2,141.92		
17	+10.16	0.00	0.0	100.0	0.00	0.0	100.0
	+ 5.08	8.45	1.1	98.9	54.69	3.5	96.5
	+ 2.54	167.48	22.1	76.8	190.68	12.1	84.4
	+ 1.59	123.00	16.2	60.6	143.58	9.1	75.3
	+ 0.95	177.13	23.4	37.2	160.59	10.2	65.1
	- 0.95	281.78	37.2		1,025.95	65.1	
	Total	757.84			1,575.49		
18	+10.16	0.00	0.0	100.0	0.00	0.0	100.0
	+ 5.08	7.79	1.1	98.9	55.80	4.3	95.7
	+ 2.54	176.26	25.4	73.5	400.69	31.1	64.6
	+ 1.59	151.19	21.8	51.7	298.05	23.1	41.5
	+ 0.95	150.69	21.8	29.9	227.98	17.7	23.8
	- 0.95	206.98	29.9		306.10	23.8	
	Total	692.91			1,288.62		
19	+10.16	0.00	0.0	100.00	0.00	0.0	100.00
	+ 5.08	17.90	2.06	97.94	5.66	0.26	99.74
	+ 2.54	168.36	19.36	78.58	210.07	9.73	90.01
	+ 1.59	191.84	22.06	56.52	326.03	15.10	74.91
	+ 0.95	161.56	18.58	37.94	395.03	18.29	56.62
	- 0.95	329.78	37.93		1,222.64	56.62	
	Total	864.44			2,159.43		
21	+10.16	0.00	0.00	100.00	0.00	0.00	100.00
	+ 5.08	5.23	0.73	99.27	67.96	4.08	95.92
	+ 2.54	148.84	20.79	78.48	342.26	20.55	75.37
	+ 1.59	120.61	16.85	61.63	192.90	11.58	63.79
	+ 0.95	174.17	24.33	37.30	261.21	15.68	48.11
	- 0.95	267.05	37.30		801.13	48.11	
	Total	715.90				1,665.46	

TABLE D-7. SAMPLE COMPOSITION--RICHMOND, CALIFORNIA

			Lights						Heavies					
Run No.	Air Setting	Screen Size (cm)	Paper and Plastic wt (g)	Aluminum wt (g)	Ferrous wt (g)	Other wt (g)	Total wt (g)	14 Mesh grit wt (g)	Paper and Plastic wt (g)	Aluminum wt (g)	Ferrous wt (g)	Other wt (g)	Total wt (g)	14 Mesh grit wt (g)
1	154.07 m³/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	32.45	0.00	0.00	0.00	32.45		0.59	26.02	66.65	0.00	93.26	
		+ 2.54	291.82	0.97	34.96	11.24	338.99		13.08	59.69	389.77	113.43	575.97	
		+ 1.59	212.37	0.00	6.44	135.00	353.81		8.09	37.92	288.75	174.04	508.80	
		+ 0.95	192.28	3.55	0.00	20.47	216.30		14.68	17.63	173.54	283.35	489.20	
		- 0.95	94.96	0.00	0.43	138.03	232.72		31.98	0.00	52.48	1,291.50	1,375.96	
		Total	823.18	4.52	41.83	304.74	1,174.27	58.93	68.42	141.26	971.19	1,862.32	3,043.19	35.44
2 *	154.07 m³/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	30.93	0.00	0.00	0.00	30.93		2.25	0.00	16.08	1.78	20.11	
		+ 2.54	393.16	2.10	5.13	11.33	411.72		16.77	40.99	605.24	47.27	710.27	
		+ 1.59	225.00	10.43	52.38	15.65	303.46		14.43	39.61	403.68	104.82	562.54	
		+ 0.95	245.90	10.77	23.24	36.86	316.77		21.93	10.63	303.75	250.38	586.69	
		- 0.95	158.31	4.08	0.00	462.11	624.50		38.27	28.34	92.49	1,300.48	1,459.58	
		Total	1,053.30	27.38	80.75	525.95	1,687.38	202.26	93.65	119.57	1,421.24	1,704.73	3,339.19	45.44
3	154.07 m³/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	14.07	0.00	0.00	1.37	15.44		0.22	0.00	223.75	0.42	224.39	
		+ 2.54	202.83	21.38	0.00	18.57	242.78		104.38	192.91	998.01	136.35	1,431.65	
		+ 1.59	271.49	8.33	15.85	20.62	316.29		109.20	44.60	549.91	198.18	901.89	
		+ 0.95	262.74	10.01	6.34	37.23	316.32		136.11	14.72	286.04	641.33	1,078.20	
		- 0.95	221.28	1.03	12.32	645.36	879.99		153.77	6.78	56.20	2,716.79	2,933.54	
		Total	972.41	40.75	34.51	723.15	1,770.82	332.20	503.68	259.01	2,113.91	3,693.07	6,569.67	231.08
4	154.07 m³/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	17.29	0.00	0.00	0.00	17.29		12.40	0.00	0.00	0.00	12.40	
		+ 2.54	336.33	1.76	15.34	38.55	391.98		129.13	102.42	1,159.19	113.31	1,504.05	
		+ 1.59	392.19	2.57	0.00	34.76	429.52		186.26	68.62	1,111.98	167.00	1,533.86	
		+ 0.95	292.95	7.29	14.14	30.33	344.71		301.41	9.15	665.13	447.84	1,423.53	
		- 0.95	244.44	0.00	0.00	463.42	707.86		179.09	0.00	147.35	1,617.37	1,943.81	
		Total	1,283.20	11.62	29.48	567.06	1,891.36	285.05	808.29	180.19	3,083.65	2,345.52	6,417.37	219.89

(continued)

TABLE D-7. (continued)

			Lights						Heavies					
Run No.	Air Setting	Screen Size (cm)	Paper and Plastic wt (g)	Aluminum wt (g)	Ferrous wt (g)	Other wt (g)	Total wt (g)	14 Mesh grit wt (g)	Paper and Plastic wt (g)	Aluminum wt (g)	Ferrous wt (g)	Other wt (g)	Total wt (g)	14 Mesh grit wt (g)
5	154.07 m^3/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	9.07	0.00	0.00	0.00	9.07		16.21	0.00	0.00	0.00	16.21	
		+ 2.54	277.09	7.37	0.00	15.28	299.74		187.37	56.44	293.71	28.34	565.86	
		+ 1.59	154.86	0.00	5.85	0.27	160.98		110.70	32.89	387.69	85.35	616.63	
		+ 0.95	253.94	3.83	0.00	11.86	269.63		185.87	4.76	361.88	93.80	646.31	
		- 0.95	235.22	5.03	0.00	589.69	829.94		110.40	0.00	168.79	736.42	1,015.61	
		Total	930.18	16.23	5.85	617.10	1,569.36	318.17	610.55	94.09	1,212.07	943.91	2,860.62	187.23
8	102.19 m^3/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	63.39	0.00	0.00	0.00	63.39		22.78	0.00	92.69	26.80	142.27	
		+ 2.54	390.29	0.00	0.00	13.34	403.63		54.43	88.97	803.40	83.57	1,030.37	
		+ 1.59	356.28	3.00	0.00	16.65	375.93		58.77	4.34	373.44	49.39	1,485.94	
		+ 0.95	158.52	0.84	0.00	19.61	178.97		66.97	4.22	261.79	81.39	414.37	
		- 0.95	82.65	4.85	0.00	297.51	385.01		80.20	0.00	39.59	604.45	724.24	
		Total	1,051.13	8.69	0.00	347.11	1,406.93	182.78	283.15	99.53	1,570.91	843.60	2,797.19	91.47
9	102.19 m^3/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	21.65	0.00	0.00	2.82	24.47		22.00	0.00	0.00	20.60	42.60	
		+ 2.54	151.78	0.00	0.00	17.00	168.78		127.94	20.76	385.69	167.27	701.66	
		+ 1.59	221.34	0.00	0.00	11.62	232.96		145.72	10.90	300.56	136.71	593.89	
		+ 0.95	242.35	2.36	0.00	28.41	273.12		223.70	6.77	189.43	207.28	627.18	
		- 0.95	234.08	3.59	0.00	476.47	714.14		212.48	0.00	18.21	1,528.52	1,759.21	
		Total	871.20	5.95	0.00	536.32	1,413.47	271.00	731.84	38.43	893.89	2,060.38	3,724.54	248.28
10	102.19 m^3/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	14.65	0.00	0.00	0.00	14.65		7.94	0.00	0.00	51.70	54.64	
		+ 2.54	185.62	0.00	0.00	60.48	246.10		69.06	108.53	531.50	257.75	966.84	
		+ 1.59	139.89	3.62	0.00	23.01	166.52		84.83	28.16	177.25	189.78	480.02	
		+ 0.95	221.69	5.23	5.86	24.03	256.81		129.45	30.76	147.11	276.52	583.84	
		- 0.95	88.82	11.18	0.00	610.60	710.60		121.80	0.00	64.03	1,552.16	1,737.99	
		Total	650.67	20.03	5.86	718.12	1,394.68	348.16	413.08	167.45	919.89	2,327.91	3,828.33	150.00
11	102.19 m^3/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	0.00	0.00	0.00	0.00	0.00		2.66	0.00	0.00	30.73	33.39	
		+ 2.54	129.47	0.00	0.00	59.56	189.03		36.68	19.89	203.92	43.67	304.16	
		+ 1.59	90.03	0.00	7.64	12.37	110.04		30.57	9.26	126.22	53.72	219.77	
		+ 0.95	188.49	0.00	0.00	22.44	210.93		37.43	1.94	69.81	158.55	267.73	
		- 0.95	134.67	6.89	0.00	646.78	787.94		33.71	23.42	67.42	967.86	1,092.41	
		Total	542.26	6.89	7.64	741.15	1,297.94	435.39	141.05	54.51	467.37	1,254.53	1,917.46	76.88

(continued)

TABLE D-7. (continued)

			Lights						Heavies					
Run No.	Air Setting	Screen Size (cm)	Paper and Plastic wt (g)	Aluminum wt (g)	Ferrous wt (g)	Other wt (g)	Total wt (g)	14 Mesh grit wt (g)	Paper and Plastic wt (g)	Aluminum wt (g)	Ferrous wt (g)	Other wt (g)	Total wt (g)	14 Mesh grit wt (g)
12	102.19 m^3/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	2.48	0.00	0.00	0.00	2.48		23.08	0.00	0.00	16.29	39.37	
		+ 2.54	165.58	0.00	0.00	8.07	173.65		190.73	23.41	287.75	90.73	592.62	
		+ 1.59	220.43	1.29	0.00	18.63	240.35		246.25	18.54	176.90	109.39	551.08	
		+ 0.95	234.00	4.31	0.00	15.47	253.78		220.41	7.90	35.72	116.34	380.37	
		- 0.95	62.01	4.94	1.36	594.72	663.03		138.08	11.34	85.47	973.64	1,208.53	
		Total	684.50	10.54	1.36	636.89	1,333.29	251.64	818.55	61.19	585.84	1,306.39	2,771.99	211.04
13	102.19 m^3/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	4.51	0.00	0.00	0.00	4.51		13.34	0.00	0.00	0.00	13.34	
		+ 2.54	137.32	0.00	8.61	4.85	150.78		159.01	0.22	25.39	25.43	210.05	
		+ 1.59	192.89	0.00	0.00	17.61	210.50		156.20	28.00	73.73	75.04	332.97	
		+ 0.95	243.30	2.09	0.00	12.83	285.22		239.67	0.20	6.34	99.32	345.53	
		- 0.95	172.86	2.04	0.00	455.64	630.54		292.86	6.04	0.00	621.92	920.82	
		Total	750.88	4.13	8.61	490.93	1,254.55	214.30	861.08	34.46	105.46	821.71	1,822.71	203.98
14	102.19 m^3/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 2.54	217.23	0.00	0.00	68.22	285.45		26.17	30.06	170.24	64.84	291.31	
		+ 1.59	208.42	3.77	0.00	39.54	251.54		20.75	15.47	105.07	31.71	173.00	
		+ 0.95	190.69	1.41	0.00	15.40	207.50		32.09	4.84	58.70	52.06	147.69	
		- 0.95	133.16	0.80	0.00	137.67	271.63		55.61	0.59	33.38	246.34	335.92	
		Total	749.50	5.98	0.00	260.64	1,016.12	102.10	134.62	50.96	367.39	394.95	947.92	32.37
15	78.66 m^3/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 2.54	137.96	0.87	0.00	2.12	140.95		133.19	12.20	0.00	4.00	149.39	
		+ 1.59	169.73	0.00	0.00	6.97	176.70		172.15	24.11	49.59	123.98	369.83	
		+ 0.95	171.07	1.22	0.00	7.06	179.35		170.06	5.90	2.91	91.69	270.56	
		- 0.95	81.87	2.46	0.00	213.79	298.12		66.29	0.56	4.92	662.02	733.79	
		Total	560.63	4.55	0.00	229.94	795.12	135.37	541.69	42.77	57.42	881.69	1,523.57	162.17
16	78.66 m^3/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	6.31	0.00	0.00	0.00	6.31		0.00	0.00	0.00	0.00	0.00	
		+ 2.54	132.94	0.00	0.00	2.10	135.04		185.87	23.58	91.92	82.70	384.07	
		+ 1.59	128.72	0.00	0.00	7.92	136.64		131.05	32.87	82.31	30.79	277.04	
		+ 0.95	128.00	0.00	0.00	3.43	131.43		147.66	17.62	72.34	135.17	372.79	
		- 0.95	99.33	0.00	0.00	105.40	204.73		151.44	8.89	75.48	872.21	1,108.02	
		Total	495.30	0.00	0.00	118.85	614.15	89.72	616.04	82.96	322.05	1,120.87	2,141.92	160.21

(continued)

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TABLE D-7. (concluded)

			Lights						Heavies					
Run No.	Air Setting	Screen Size (cm)	Paper and Plastic wt (g)	Aluminum wt (g)	Ferrous wt (g)	Other wt (g)	Total wt (g)	14 Mesh grit wt (g)	Paper and Plastic wt (g)	Aluminum wt (g)	Ferrous wt (g)	Other wt (g)	Total wt (g)	14 Mesh grit wt (g)
17	78.66 m^3/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	6.74	0.00	0.00	1.71	8.45		14.11	0.00	0.00	40.58	54.69	
		+ 2.54	161.26	0.00	0.00	6.22	167.48		104.91	1.72	47.22	37.55	190.68	
		+ 1.59	118.56	0.00	0.00	4.44	123.00		46.23	10.91	36.79	49.65	143.58	
		+ 0.95	173.75	0.34	0.00	3.04	177.13		55.23	11.80	34.42	59.14	160.59	
		- 0.95	126.48	0.00	0.00	155.30	281.78		91.29	11.30	20.48	902.88	1,025.95	
		Total	586.79	0.34	0.00	170.71	757.84	126.91	311.05	35.73	138.91	1.089.80	1,575.49	229.09
18	78.66 m^3/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	7.79	0.00	0.00	0.00	7.79		55.18	0.00	0.00	0.62	55.80	
		+ 2.54	157.23	0.00	0.00	19.03	176.26		205.64	10.22	128.74	56.09	400.69	
		+ 1.59	141.61	1.29	0.00	8.29	151.19		211.44	32.05	6.69	47.87	298.05	
		+ 0.95	144.02	0.84	0.00	5.83	150.69		167.39	6.66	19.02	34.91	227.98	
		- 0.95	94.21	4.16	0.00	108.61	206.98		98.08	8.74	0.00	199.28	306.10	
		Total	544.86	6.29	0.00	141.76	692.91	90.82	737.73	57.67	154.45	388.77	1,288.62	68.63
19	78.66 m^3/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	17.74	0.00	0.00	0.16	17.90		5.51	0.00	0.00	0.15	5.66	
		+ 2.54	107.52	0.00	0.00	60.84	168.36		146.68	9.62	6.15	47.62	210.07	
		+ 1.59	121.77	0.29	4.33	65.45	191.84		170.00	0.77	75.24	80.02	326.03	
		+ 0.95	141.27	0.17	0.00	20.12	161.56		276.04	7.51	25.93	85.55	395.03	
		- 0.95	86.13	0.00	0.00	243.65	329.78		516.98	0.00	0.00	705.66	1,222.64	
		Total	474.43	0.46	4.33	390.22	869.44	137.62	1,115.21	17.90	107.32	919.00	2,159.43	292.43
21	78.66 m^3/min	+10.16	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
		+ 5.08	5.23	0.00	0.00	0.00	5.23		7.92	0.00	49.54	10.50	67.96	
		+ 2.54	125.83	0.00	0.00	23.01	148.84		122.15	9.21	149.26	61.64	342.26	
		+ 1.59	120.61	0.00	0.00	0.00	120.61		97.24	3.43	36.29	55.94	192.90	
		+ 0.95	168.52	0.00	0.00	5.65	174.17		184.37	8.58	5.52	62.74	261.21	
		- 0.95	83.22	1.37	0.00	182.46	267.05		258.26	1.74	27.39	513.74	801.13	
		Total	503.41	1.37	0.00	211.12	715.90	104.87	669.94	22.96	268.00	704.56	1,665.46	171.75

* All metals above + 0.95 have been separated and not ground or ashed.

TABLE D-8. MOISTURE CONTENT, INITIAL TO AIR DRIED CONDITION--RICHMOND

Run No.	Lights Initial weight (g)	Final weight (g)	Moisture weight (g)	Moisture content (%)	Heavies Initial weight (g)	Final weight (g)	Moisture weight (g)	Moisture content (%)
1	1,335	1,136	199	14.9	3,267	3,040	227	6.9
2	2,157	1,703	454	21.0	3,575	3,377	198	5.5
3	2,412	1,788	624	25.9	8,713	6,619	2,094	24.0
4	2,415	1,903	512	21.0	7,585	6,420	1,165	15.4
5	2,242	1,646	596	26.6	3,717	2,866	851	22.9
8	1,449	1,420	29	2.0	2,869	2,813	56	1.9
9	1,646	1,412	234	14.2	4,114	3,717	397	9.6
10	1,561	1,419	142	9.1	4,091	3,835	256	6.3
11	1,449	1,278	171	11.8	2,017	1,932	85	4.2
12	1,390	1,334	56	4.0	3,068	2,784	284	9.3
13	1,363	1,250	113	8.3	2,045	1,846	199	9.7
14	1,050	993	57	5.4	994	938	56	5.6
15	966	795	171	17.7	1,903	1,506	397	20.9
16	738	625	113	15.3	2,472	2,131	341	13.8
17	881	767	114	12.9	1,873	1,561	312	16.7
18	794	681	113	14.2	1,477	1,278	199	13.5
19	1,078	879.6	198.4	18.4	2,866	2,185	681	23.8
21	851.3	709.4	141.9	16.7	2,015	1,674	341	16.9

Sample Calculation: Moisture Content - initial to air-dried condition

$$\text{Percent Moisture Content} = \frac{\text{Initial Weight} - \text{Final Weight}}{\text{Initial Weight}} \times 100$$

$$\text{For Run No. 1 Lights} = \frac{1{,}335 - 1{,}136}{1{,}335} \times 100 = 14.9\%$$

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(PREVIOUSLY EIN. EPA FORM 287)
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TABLE D-9. POWER MEASUREMENTS--RICHMOND, CALIFORNIA

Air Setting	Airflow Conditions (fpm)	Power (kW) Blower	Power (kW) Airlock	Power (kW) Total
High	1,296.00	16.3	0.3	16.6
Middle	859.58	12.3	0.3	12.6
Low	661.67	9.8	0.3	10.1

APPENDIX E

FIELD TEST DATA FOR MODIFIED VERTICAL RECTANGULAR AIR CLASSIFIER--AMES, IOWA

TABLE E-1. SUMMARY OF OPERATIONAL DATA--AMES

Run No.	Input feed rate (Mg/h)	Lights feed rate (Mg/h)	Split percent lights	Air setting (m^3/min)	Ash percent in lights	Ash percent in heavies	Paper + plastic percent in lights	Air Dry Moisture Content Percent in infeed	Paper + plastic percent in heavies	Higher heating Value,[b] kJ/kg Lights	Higher heating Value,[b] kJ/kg Heavies
1	18.05	15.80	87.50	664	20.7	42.4	70.09	20.09	22.40		
2	2.09	1.78	85.17	664	22.6	67.5	67.25	12.4	5.66	19,801	7,848
3	9.00	7.65	85.00	664	12.2	62.3	76.73	10.8	2.50	18,120	7,052
4	21.00	17.69	84.21	664	20.5	69.4	63.02	16.4	5.84		
5	3.21	1.70	52.94	664	11.9	65.2	134.06	7.9	2.46		
6	3.69	2.96	80.16	618	7.6	56.3	87.59	9.5	2.16	20,950	7,908
7	13.93	13.46	96.61	618	19.4	31.2	65.53	19.1	33.07		
8	11.49	8.88	77.29	618							
9	3.23	2.10	64.91	618	12.6	51.5	92.94	9.1	4.91	24,083	11,183
10	10.89	8.03	73.78	618							
11	20.43	16.70	81.76	618	10.7	32.5	93.70	10.8	14.35		
12	20.27	14.49	71.47	618	10.8	37.8	98.25	7.3	2.63		
13	31.75	28.06	88.38	668	22.2	51.4	70.16	17.8	25.34	16,961	9,906
14	12.67	11.00	86.85	668							
15	7.00	6.64	94.81	668	3.8	28.8	89.47	12.9	6.35	17,194	19,540
16	15.94	14.87	93.29	668	3.5	34.9	92.81	29.4	7.70		
17	2.67	2.39	89.51	668	11.0	67.3	95.55	10.0	9.51	19,317	7,604
18	12.77	11.34	88.80	668	11.4	46.4	70.20	12.7	6.06		
19	19.85	14.27	71.91	668	17.8	50.3	85.79	32.4	13.44	19,827	10,332

[a] Calculated from paper and plastic in infeed and heavies stream.

[b] Oven dried basis.

[c] Higher heating value of lights calculated using higher heating values of infeed and heavies samples and mass split values.

TABLE E-2. FEED RATES--AMES

Date 1979	Airflow setting	Run No.	Input: Sample weight (kg)	Input: Tare weight (kg)	Input: Balance weight (kg)	Input: Sample Time (sec)	Input: Feed rate (Mg/h)	Heavies: Sample weight (kg)	Heavies: Tare weight (kg)	Heavies: Balance weight (kg)	Heavies: Sample Time (sec)	Heavies: Feed rate (Mg/h)	Lights: Feed rate (Mg/h)
8-8	10.95 m^3/s	1	41.46	18.39	23.07	4.6	18.05	29.94	4.54	25.40	40.5	2.26	15.80
8-8		2	26.93	18.39	8.54	14.7	2.09	11.52	4.54	6.98	81.0	0.31	1.78
8-8		3	35.89	18.39	17.51	7.0	9.00	13.62	4.54	9.08	24.2	1.35	7.65
8-8		4	51.64	18.39	33.26	5.7	21.00	17.99	4.54	13.45	14.6	3.32	17.69
8-8		5	26.13	18.39	7.75	8.7	3.21	13.51	4.54	8.97	21.4	1.51	1.70
8-8		6	26.79	18.39	8.40	8.2	3.69	10.70	4.54	6.15	30.3	0.73	2.96
8-8	10.19 m/s	7	43.92	18.39	25.54	6.6	13.93	24.57	4.54	20.03	152.5	0.47	13.46
8-8		8	38.82	18.39	20.43	6.4	11.49	19.04	4.54	14.50	20.0	2.61	8.88
8-8		9	28.72	18.39	10.33	11.5	3.23	12.51	4.54	7.97	25.3	1.13	2.10
8-8		10	34.42	18.39	16.03	5.3	10.89	17.71	4.54	13.17	16.6	2.86	8.03
8-8		11	43.92	18.39	25.54	4.5	20.43	21.93	4.54	17.39	16.8	3.73	16.70
8-8		12	39.78	18.39	21.39	3.8	20.27	21.57	4.54	17.03	10.6	5.78	14.49
8-9	11.01 m/s	13	51.02	18.39	32.63	3.7	31.75	24.94	4.54	20.40	19.9	3.69	28.05
8-9		14	34.93	18.39	16.54	4.7	12.67	12.31	4.54	7.77	16.8	1.67	11.00
8-9		15	28.89	18.39	10.50	5.4	7.00	7.72	4.54	3.18	31.5	0.36	6.64
8-9		16	40.97	18.39	22.59	5.1	15.94	12.66	4.54	8.12	27.3	1.07	14.87
8-9		17	24.32	18.39	5.93	8.0	2.67	6.64	4.54	2.10	27.0	0.28	2.39
8-9		18	36.83	18.39	18.44	5.2	12.77	11.89	4.54	7.35	18.5	1.43	11.34
8-9		19	42.65	18.39	24.26	4.4	19.85	21.11	4.54	16.57	10.7	5.57	14.27

TABLE E-3. AIRFLOW, LOWEST RATE SETTING--AMES

Date: 8-7-79	Point	Traverse location (cm)	Total pressure		Pressure drop (in H_2O)	Velocity press.		Air density σ_A (lb/ft)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m)	Airflow rate (m/min)	Airflow rate (Mg/h)
			inlet Δh (in H_2O)	outlet Δh (in H_2O)		inlet Δh_i (in H_2O)	$\sqrt{\Delta h_i}$						
	1	3.02	-6.70	8.90		0.635	0.80						
Barometric Pressure: 28.96 in Hg	2	7.94	-6.90	8.90		0.830	0.91						
T_d = 32.22°C (90°F)	3	13.97	-6.80	8.90		0.920	0.96						
T_w = 25.83°C (78.5°F)	4	20.70	-6.70	8.85		0.935	0.97						
In Duct (above air classifier)	5	31.04	-6.80	8.90		1.000	1.00						
	6	60.80	-6.80	9.20		1.100	1.05						
	7	71.25	-6.70	9.45		1.050	1.02						
	8	78.74	-6.70	9.65		1.200	1.10						
	9	84.61	-6.80	9.90		1.250	1.12						
	10	89.69	-6.80	10.00		0.970	0.98						
Average			-6.77	9.27	16.04	0.989	0.99	0.0703	3507.4	1069.1	0.657	702.4	47.5
In Air Classifier	1		0.00			0.45	0.67						
Barometric Pressure: 28.87 in Hg	2		0.00			0.49	0.70						
T_d = 25.56°C (78°F)	3		0.00			0.68	0.82						
T_w = 22.22°C (72°F)	4		0.00			0.80	0.89						
	5		0.00			0.64	0.80						
	6		0.00			0.42	0.65						
	7		0.00			0.24	0.49						
	8		0.00			0.08	0.28						
	9		0.00			0.06	0.24						
Average							0.62	0.0723	2166.62	660.39	1.01	668.13	46.49

TABLE E-4. AIRFLOW, MIDDLE RATE SETTING--AMES

Date: 8-8-79		Traverse location (cm)	Total pressure		Pressure drop (in H_2O)	Velocity press. inlet Δh_1 (in H_2O)	$\sqrt{\Delta h_1}$	Air density σ_A (lb/ft^3)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m^2)	Airflow rate (m^3/min)	Airflow rate (Mg/h)
			inlet Δh (in H_2O)	outlet Δh (in H_2O)									
Baro. press: 28.96 in Hg													
In duct above Air Classifier	1	3.02	-8.30	9.00		0.64	0.80						
T_d = 31.39°C (88.5°F)	2	7.94	-8.40	9.00		0.99	0.99						
T_w = 25.56°C (78°F)	3	13.97	-8.40	9.00		0.98	0.99						
	4	20.70	-8.40	9.00		1.20	1.10						
	5	31.04	-8.40	9.00		1.20	1.10						
	6	60.80	-8.40	9.20		1.40	1.18						
	7	71.25	-8.40	9.50		1.35	1.16						
	8	78.74	-8.40	9.70		1.35	1.16						
	9	84.61	-8.40	10.00		1.30	1.14						
	10	89.69	-8.40	10.00		1.10	1.05						
Average			-8.39	9.34	17.73	1.15	1.07	0.0698	3806.1	1160.1	0.657	762.2	51.20
In Air classifier	1		0.00			0.44	0.66						
Baro. Press: 28.87 in Hg	2		0.00			0.46	0.68						
T_d = 28.89°C (84°F)	3		0.00			0.57	0.75						
T_w = 21.11°C (70°F)	4		0.00			0.57	0.75						
	5		0.00			0.57	0.75						
	6		0.00			0.44	0.66						
	7		0.00			0.20	0.45						
	8		0.00			0.08	0.28						
	9		0.00			0.03	0.17						
Average							0.57	0.0713	2005.70	611.34	1.01	618.51	42.45

TABLE E-5. AIRFLOW, HIGHEST RATE SETTING--AMES

Date: 8-6-79		Traverse location (cm)	Total pressure inlet Δh (in H_2O)	Total pressure outlet Δh (in H_2O)	Pressure drop (in H_2O)	Velocity press. inlet Δh_i (in H_2O)	$\sqrt{\Delta h_i}$	Air density σ_A (lb/ft^3)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m^2)	Airflow rate (m^3/min)	Airflow rate (Mg/h)
Baro. press: 28.96 in Hg													
In Duct above Air Classifier	1	3.02	-8.20			0.74	0.86						
T_d = 32.78°C (91°F)	2	7.94	-8.10			1.15	1.07						
T_w = 26.39°C (79.5°F)	3	13.97	-8.00			1.30	1.14						
	4	20.70	-8.10			1.30	1.14						
	5	31.04	-8.10			1.40	1.18						
	6	60.80	-8.10			1.50	1.22						
	7	71.25	-8.10			1.45	1.20						
	8	78.74	-8.10			1.40	1.18						
	9	84.61	-8.40			1.30	1.14						
	10	89.69	-8.20			1.05	1.02						
Average			-8.14				1.12	0.0696	3989.7	1216.1	0.657	799.0	53.5
In Air Classifier	1		0.00			0.48	0.69						
T_d = 31.67°C (89°F)	2		0.00			0.52	0.72						
T_w = 21.11°C (70°F)	3		0.00			0.61	0.78						
	4		0.00			0.62	0.79						
	5		0.00			0.65	0.81						
	6		0.00			0.48	0.69						
	7		0.00			0.32	0.57						
	8		0.00			0.08	0.28						
	9		0.00			0.04	0.20						
Average							0.61	0.0708	2154.68	656.76	1.01	664.45	45.26

TABLE E-6. PARTICLE SIZE DISTRIBUTION--AMES

Run No.	Screen size (cm)	Infeed			Heavies		
		Total weight (g)	% Retained	Cumulative % passing	Total weight (g)	% Retained	Cumulative % passing
1	+5.08	127.88	3.8	96.2	345.62	7.7	92.3
	+2.54	997.51	29.3	66.9	1973.67	44.1	48.2
	+1.59	508.16	14.9	52.0	684.97	15.3	32.9
	+0.95	641.51	18.8	33.2	682.16	15.2	17.7
	+0.51	767.68	22.5	10.7	707.87	15.8	1.9
	-0.51	366.24	10.7		85.60	1.9	
	Total	3408.98			4479.89		
2	+10.16	373.65	10.1	89.9			
	+5.08	556.49	15.0	74.9	1061.72	27.3	72.7
	+2.54	2183.00	59.0	15.9	2344.93	60.2	12.5
	+1.59	163.31	4.4	11.5	192.75	4.9	7.6
	+0.95	207.65	5.6	5.9	177.64	4.6	3.0
	+0.51	140.10	3.8	2.1	108.30	2.8	0.2
	-0.51	76.95	2.1		10.44	0.3	
	Total	3701.15			3895.78		
3	+10.16				588.01	12.1	87.9
	+5.08	593.49	13.5	86.5	440.99	9.1	78.8
	+2.54	2192.43	50.0	36.5	2684.41	55.2	23.6
	+1.59	487.56	11.1	25.4	535.73	11.0	12.6
	+0.95	588.71	13.4	12.0	347.92	7.2	5.4
	+0.51	376.06	8.6	3.4	243.94	5.0	0.4
	-0.51	150.45	3.4		18.47	0.4	
	Total	4388.70			4859.47		
4	+10.16				0.0	0.0	0.0
	+5.08	236.50	4.3	95.7	392.94	5.8	94.2
	+2.54	2356.24	42.9	52.8	3341.88	49.4	44.8
	+1.59	514.85	9.4	43.4	1416.66	20.9	23.9
	+0.95	773.78	14.1	29.3	1068.03	15.8	8.1
	+0.51	1043.29	19.0	10.3	466.79	6.9	1.2
	-0.51	562.14	10.2		82.74	1.2	
	Total	5486.80			6769.04		

(continued)

TABLE E-6. (continued)

Run No.	Screen size (cm)	Infeed Total weight (g)	Infeed % Retained	Infeed Cumulative % passing	Heavies Total weight (g)	Heavies % Retained	Heavies Cumulative % passing
5	+10.16						
	+5.08	663.22	18.4	81.6	735.30	14.3	85.7
	+2.54	1986.86	55.1	26.5	3210.09	62.3	23.4
	+1.59	243.55	6.7	19.8	586.13	11.4	12.0
	+0.95	346.83	9.6	10.2	367.68	7.1	4.9
	+0.51	250.00	6.9	3.3	226.89	4.4	0.5
	-0.51	117.80	3.3		26.72	0.5	
	Total	3608.26			5152.81		
6	+10.16						
	+5.08	754.11	26.5	73.5	774.60	24.2	75.8
	+2.54	1315.05	46.1	27.4	1815.51	56.8	19.0
	+1.59	196.92	6.9	20.5	208.63	6.5	12.5
	+0.95	298.46	10.5	10.0	197.44	6.2	6.3
	+0.51	214.38	7.5	2.5	187.94	5.9	0.4
	-0.51	71.11	2.5		13.27	0.4	
	Total	2850.03			3197.39		
	+10.16						
	+5.08	361.82	8.3	91.7	414.60	10.7	89.3
	+2.54	1913.45	43.9	47.8	1983.33	51.3	38.0
	+1.59	307.99	7.1	40.7	459.64	11.9	26.1
	+0.95	628.71	14.4	26.3	415.27	10.7	15.4
	+0.51	842.46	19.3	7.0	495.71	12.8	2.6
	-0.51	306.00	7.0		94.43	2.4	
	Total	4360.43			3862.98		
9	+10.16						
	+5.08	878.84	20.8	79.2	899.82	26.1	73.9
	+2.54	2170.96	51.3	27.9	1200.38	34.9	39.0
	+1.59	322.38	7.6	20.3	604.37	17.6	21.4
	+0.95	370.11	8.7	11.6	499.02	14.5	6.9
	+0.51	358.81	8.5	3.1	204.66	5.9	1.0
	-0.51	133.93	3.2		34.02	1.0	
	Total	4235.03			3442.27		

(continued)

TABLE E-6. (continued)

Run No.	Screen size (cm)	Infeed Total weight (g)	Infeed % Retained	Infeed Cumulative % passing	Heavies Total weight (g)	Heavies % Retained	Heavies Cumulative % passing
11	+10.16						
	+5.08	590.08	14.9	85.1	422.65	8.5	91.5
	+2.54	1717.81	43.3	41.8	2565.48	51.8	39.7
	+1.59	413.71	10.4	31.4	909.89	18.4	21.3
	+0.95	600.00	15.1	16.3	701.85	14.2	7.1
	+0.51	501.84	12.7	3.6	308.45	6.2	0.9
	-0.51	143.18	3.6		42.12	0.9	
	Total	3966.62			4950.44		
12	+10.16						
	+5.08	345.29	7.8	92.2	782.53	7.9	92.1
	+2.54	1513.95	34.3	57.9	5012.25	50.4	41.7
	+1.59	741.99	16.8	41.1	1973.41	19.8	21.9
	+0.95	847.97	19.2	21.9	1328.24	13.3	8.6
	+0.51	787.82	17.9	4.0	760.35	7.6	1.0
	-0.51	175.46	4.0		97.39	1.0	
	Total	4412.48			9954.17		
13	+10.16						
	+5.08	147.87	3.1	96.9	1074.28	19.6	80.4
	+2.54	1008.53	21.4	75.5	1742.48	31.8	48.6
	+1.59	441.13	9.4	66.1	1200.84	21.9	26.7
	+0.95	1086.80	23.1	43.0	611.25	11.2	15.5
	+0.51	1645.04	34.9	8.1	765.91	14.0	1.5
	-0.51	378.68	8.0		77.98	1.4	
	Total	4708.05			5472.74		
15	+10.16						
	+5.08	1371.30	40.8	59.2	308.56	14.2	85.8
	+2.54	1465.42	43.6	15.6	1076.45	49.6	36.2
	+1.59	231.80	6.9	8.7	418.34	19.3	16.9
	+0.95	130.02	3.9	4.8	207.52	9.6	7.3
	+0.51	121.04	3.6	1.2	133.77	6.2	1.1
	-0.51	37.77	1.1		27.08	1.2	
	Total	3357.35			2171.72		

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TABLE E-6. (concluded)

		Infeed			Heavies		
Run No.	Screen size (cm)	Total weight (g)	% Retained	Cumulative % passing	Total weight (g)	% Retained	Cumulative % passing
16	+10.16						
	+5.08	643.41	21.9	78.1	371.75	8.5	91.5
	+2.54	1339.55	45.6	32.5	2486.40	56.8	34.7
	+1.59	300.00	10.2	22.3	581.09	13.3	21.4
	+0.95	300.73	10.2	12.1	576.12	13.2	8.2
	+0.51	300.34	10.2	1.9	321.89	7.4	0.8
	-0.51	53.86	1.8		38.49	0.9	
	Total	2937.89			4375.74		
17	+10.16						
	+5.08	815.46	36.2	63.8	476.78	32.4	67.6
	+2.54	1048.03	46.6	17.2	739.49	50.3	17.3
	+1.59	124.70	5.5	11.7	91.95	6.2	11.1
	+0.95	104.78	4.7	7.0	104.16	7.1	4.0
	+0.51	93.30	4.1	2.9	55.78	3.8	0.2
	-0.51	63.93	2.8		3.22	0.2	
	Total	2250.20			1471.38		
18	+10.16						
	+5.08	307.73	9.9	90.1	891.42	16.5	83.5
	+2.54	1400.75	45.1	45.0	2048.98	38.0	45.5
	+1.59	278.99	9.0	36.0	649.08	12.0	33.5
	+0.95	420.34	13.5	22.5	945.67	17.5	16.0
	+0.51	513.25	16.5	6.0	763.36	14.1	1.9
	-0.51	184.28	6.0		100.46	1.9	
	Total	3105.34			5398.97		
19	+10.16						
	+5.08	269.80	8.6	91.4	642.67	14.7	85.3
	+2.54	1046.48	33.2	58.2	1695.27	38.8	46.5
	+1.59	250.86	8.0	50.2	641.68	14.7	31.8
	+0.95	538.86	17.1	33.1	667.26	15.3	16.5
	+0.51	794.33	25.2	7.9	578.85	13.3	3.2
	-0.51	251.62	8.0		140.57	3.2	
	Total	3151.95			4366.30		

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TABLE E-7. SAMPLE COMPOSITION--AMES

Run No.	Air setting (m^3/sec)	Screen size	Infeed						Heavies					
			Paper + plastic wt (g)	NonFe wt (g)	Ferrous wt (g)	Other wt (g)	Total wt (g)	14 mesh grit (g)	Paper + plastic wt (g)	NonFe wt (g)	Ferrous wt (g)	Other wt(g)	Total wt(g)	14 mesh grit (g)
1	13.32	+5.08	127.88	0.00	0.00	0.00	127.88		169.66	116.90	0.00	59.06	345.62	
		+2.54	777.73	0.00	41.85	177.93	997.51		336.48	145.09	338.13	1153.97	1973.67	
		+1.59	403.13	6.36	0.00	98.67	508.16		79.14	2.97	138.19	464.67	684.97	
		+0.95	481.32	0.00	1.39	158.80	641.51		229.66	24.16	18.82	409.52	682.16	
		+0.51	387.88	0.00	0.00	379.80	767.68		188.58	0.98	7.58	510.73	707.87	
		-0.51	0.00	0.00	0.00	366.24	366.24		0.00	0.00	0.00	85.60	85.60	
		Total	2177.94	6.36	43.24	1181.44	3408.98	366.24	1003.52	290.10	502.72	2683.55	4479.89	85.60
2	13.32	+10.16	27.40	0.00	0.00	346.25	373.65							
		+5.08	300.25	82.75	0.00	173.49	556.49		93.51	0.00	531.23	436.98	1061.72	
		+2.54	1443.81	21.17	393.14	324.88	2183.00		54.48	110.97	1545.69	633.79	2344.93	
		+1.59	99.72	0.00	4.09	59.50	163.31		7.24	10.78	61.79	112.94	192.75	
		+0.95	144.77	0.45	10.72	51.71	207.65		35.66	7.03	45.08	89.87	177.64	
		+0.51	97.01	0.00	0.00	43.09	140.10		29.63	7.58	25.51	45.58	108.30	
		-0.51	0.00	0.00	0.00	76.95	76.95		0.00	0.00	0.00	10.44	10.44	
		Total	2112.96	104.37	407.95	1075.87	3701.15	76.95	220.52	136.36	2209.30	1329.60	3895.78	10.44
3	13.32	+10.16							0.00	0.00	0.00	588.01	588.01	
		+5.08	251.96	0.00	0.00	341.53	593.49		0.00	22.50	218.48	200.01	440.99	
		+2.54	1780.10	18.35	38.06	345.92	2192.43		26.88	379.76	1495.03	782.74	2684.41	
		+1.59	249.81	0.00	100.70	137.05	487.56		59.44	23.65	180.61	274.03	535.73	
		+0.95	424.04	2.23	24.30	138.14	588.71		23.65	21.27	111.27	191.73	347.92	
		+0.51	136.81	7.98	15.15	216.12	376.06		11.60	40.98	62.47	128.89	243.94	
		-0.51	0.00	0.00	0.00	150.45	150.45		0.00	0.00	0.00	18.47	18.47	
		Total	2852.72	28.56	178.21	1329.21	4388.70	150.45	121.57	488.16	2067.86	2181.88	4859.47	18.47

(continued)

EPA Form 2250-4 (4-80)
TYPING GUIDE SHEET

TABLE E-7. (continued)

			Infeed						Heavies					
Run No.	Air setting (m^3/sec)	Screen size	Paper + plastic wt (g)	NonFe wt (g)	Ferrous wt (g)	Other wt (g)	Total wt (g)	14 mesh grit (g)	Paper + plastic wt (g)	NonFe wt (g)	Ferrous wt (g)	Other wt(g)	Total wt(g)	14 mesh grit (g)
4	13.32	+10.16							0.00	0.00	0.00	0.00	0.00	
		+5.08	165.37	0.00	0.00	71.13	236.50		64.26	0.00	74.69	253.99	392.94	
		+2.54	1636.03	16.05	36.67	667.49	2356.24		148.95	25.88	1209.48	1957.57	3341.88	
		+1.59	313.24	0.00	19.73	181.88	514.85		63.84	15.93	380.80	956.09	1416.66	
		+0.95	528.76	0.87	0.00	244.15	773.78		84.87	3.68	779.42	200.06	1068.03	
		+0.51	271.76	1.62	12.04	757.87	1043.29		33.33	3.30	107.88	322.28	466.79	
		-0.51	0.00	0.00	0.00	562.14	562.14		0.00	0.00	0.00	82.74	82.74	
		Total	2915.16	18.54	68.44	2484.66	5486.80	562.14	395.25	48.79	2552.27	3772.73	6769.04	82.74
5	13.32	+5.08	479.68	0.00	0.00	183.54	663.22		12.09	0.00	219.49	503.72	735.30	
		+2.54	1462.70	2.28	137.21	384.67	1986.86		51.49	210.07	2064.13	884.40	3210.09	
		+1.59	184.03	0.00	0.00	59.52	243.55		16.19	15.43	227.26	327.25	586.13	
		+0.95	264.47	2.63	4.59	75.14	346.83		27.84	10.79	67.73	261.32	367.68	
		+0.51	157.53	12.35	9.19	70.93	250.00		19.30	7.45	41.32	158.82	226.89	
		-0.51	0.00	0.00	0.00	117.80	117.80		0.00	0.00	0.00	26.72	26.72	
		Total	2548.41	17.26	150.99	891.60	3608.26	117.80	126.91	243.74	2619.93	2162.23	5152.81	26.72
6	12.70	+5.08	477.76	0.44	8.25	267.66	754.11		15.86	119.08	18.39	621.27	774.60	
		+2.54	922.24	10.40	0.00	382.41	1315.05		31.98	76.18	1152.31	555.04	1815.51	
		+1.59	167.92	0.00	0.00	29.00	196.92		9.28	6.18	34.75	158.42	208.63	
		+0.95	263.50	2.80	8.60	23.56	298.46		6.05	3.26	40.02	148.11	197.44	
		+0.51	158.43	0.00	0.00	55.95	214.38		6.00	2.39	36.88	142.67	187.94	
		-0.51	0.00	0.00	0.00	71.11	71.11		0.00	0.00	0.00	13.27	13.27	
		Total	1989.85	13.64	16.85	829.69	2850.03	71.11	69.17	207.09	1282.35	1638.78	3197.39	13.27

(continued)

TABLE E-7. (continued)

Run No.	Air setting (m^3/sec)	Screen size	Infeed Paper + plastic wt (g)	Infeed NonFe wt (g)	Infeed Ferrous wt (g)	Infeed Other wt (g)	Infeed Total wt (g)	Infeed 14 mesh grit (g)	Heavies Paper + plastic wt (g)	Heavies NonFe wt (g)	Heavies Ferrous wt (g)	Heavies Other wt(g)	Heavies Total wt(g)	Heavies 14 mesh grit (g)
7	12.70	+5.08	245.20	6.17	7.66	102.79	361.82		162.21	8.77	0.00	243.62	414.60	
		+2.54	1305.06	4.83	0.00	603.56	1913.45		573.71	82.14	403.02	924.46	1983.33	
		+1.59	225.32	0.00	0.00	82.67	307.99		136.00	6.86	128.32	188.46	459.64	
		+0.95	459.84	3.03	0.00	165.84	628.71		198.13	0.00	0.00	217.14	415.27	
		+0.51	575.42	2.23	0.00	264.81	842.46		207.60	4.68	0.00	283.43	495.71	
		-0.51	0.00	0.00	0.00	306.00	306.00		0.00	0.00	0.00	94.43	94.43	
		Total	2810.84	16.26	7.66	1525.67	4360.43	306.00	1277.65	102.45	531.34	1951.54	3862.98	94.43
9	12.70	+5.08	481.64	0.00	1.53	395.67	878.84		24.21	0.00	219.78	655.83	899.82	
		+2.54	1651.11	50.28	0.00	469.57	2170.96		61.43	228.85	216.33	693.77	1200.38	
		+1.59	178.82	2.29	55.90	85.37	322.38		28.77	0.00	153.04	422.56	604.37	
		+0.95	240.18	2.13	1.92	125.88	370.11		41.11	2.79	40.52	414.60	499.02	
		+0.51	135.23	0.00	31.71	191.87	358.81		13.47	5.15	27.60	158.44	204.66	
		-0.51	0.00	0.00	0.00	133.93	133.93		0.00	0.00	0.00	34.02	34.02	
		Total	2686.98	54.70	91.06	1402.29	4235.03	133.93	168.99	236.79	657.27	2379.22	3442.27	34.02
11	12.70	+5.08	511.01	0.00	0.00	79.07	590.08		140.89	19.48	10.92	251.36	422.65	
		+2.54	1518.71	0.00	0.00	199.10	1717.81		370.20	53.96	555.41	1585.91	2565.48	
		+1.59	276.08	0.00	0.00	137.63	413.71		86.74	5.36	120.26	697.53	909.89	
		+0.95	435.74	0.00	0.00	164.26	600.00		91.50	236.65	102.50	271.20	701.85	
		+0.51	427.61	0.00	0.00	74.23	501.84		21.28	4.23	151.41	131.53	308.45	
		-0.51	0.00	0.00	0.00	143.18	143.18		0.00	0.00	0.00	42.12	42.12	
		Total	3169.15	0.00	0.00	797.47	3966.62	143.18	710.61	319.68	940.50	2979.65	4950.44	42.12
12	12.70	+5.08	292.49	0.00	0.00	52.80	345.29		20.61	19.82	225.93	516.17	782.53	
		+2.54	998.56	34.30	107.17	373.92	1513.95		121.25	76.79	1210.34	3603.87	5012.25	
		+1.59	461.66	17.24	0.00	263.09	741.99		47.26	0.00	72.48	1853.67	1973.41	
		+0.95	703.85	0.00	0.00	144.12	847.97		35.71	3.56	141.02	1147.95	1328.24	
		+0.51	642.13	1.02	0.00	144.67	787.82		37.05	5.17	196.54	521.59	760.35	
		-0.51	0.00	0.00	0.00	175.46	175.46		0.00	0.00	0.00	97.39	97.39	
		Total	3098.69	52.56	107.17	1154.06	4412.48	175.46	261.88	105.34	1846.31	7740.64	9954.17	97.39

(continued)

TABLE E-7. (continued)

Run No.	Air setting (m^3/sec)	Screen size	Infeed: Paper + plastic wt (g)	Infeed: NonFe wt (g)	Infeed: Ferrous wt (g)	Infeed: Other wt (g)	Infeed: Total wt (g)	Infeed: 14 mesh grit (g)	Heavies: Paper + plastic wt (g)	Heavies: NonFe wt (g)	Heavies: Ferrous wt (g)	Heavies: Other wt(g)	Heavies: Total wt(g)	Heavies: 14 mesh grit (g)
13	11.74	+5.08	51.46	0.00	0.00	96.41	147.87		50.33	321.88	46.78	655.29	1074.28	
		+2.54	712.25	16.50	143.91	135.87	1008.53		84.23	50.22	1118.70	489.31	1742.48	
		+1.59	308.39	0.00	0.00	132.74	441.13		374.04	29.42	57.52	739.86	1200.84	
		+0.95	831.22	0.00	0.00	255.58	1086.80		312.80	6.69	18.17	273.59	611.25	
		+0.51	1138.17	0.00	0.00	506.87	1645.04		565.53	0.00	26.14	174.24	765.91	
		-0.51	0.00	0.00	0.00	378.68	378.68		0.00	0.00	0.00	77.98	77.98	
		Total	3041.49	16.50	143.91	1506.15	4708.05	378.68	1386.95	408.21	1267.31	2410.27	5472.74	77.98
15	11.74	+5.08	1343.77	0.00	0.00	27.53	1371.30		0.00	0.00	98.53	210.03	308.56	
		+2.54	1403.43	13.62	0.00	48.37	1465.42		46.39	13.62	299.04	717.40	1076.45	
		+1.59	209.93	0.00	0.00	21.87	231.80		24.30	0.00	32.09	361.95	418.34	
		+0.95	117.70	0.00	0.00	12.32	130.02		38.63	0.68	18.15	150.06	207.52	
		+0.51	97.04	0.41	0.00	23.59	121.04		28.52	0.18	12.33	92.74	133.77	
		-0.51	0.00	0.00	0.00	37.77	37.77		0.00	0.00	0.00	27.08	27.08	
		Total	3171.87	14.03	0.00	171.45	3357.35	37.77	137.84	14.48	466.34	1553.06	2171.72	27.08
16	11.74	+5.08	628.75	0.00	0.00	14.66	643.41		87.46	0.00	183.11	101.18	371.75	
		+2.54	1244.12	6.24	0.00	89.19	1339.55		163.89	98.55	744.78	1479.18	2486.40	
		+1.59	264.70	0.00	0.00	35.30	300.00		36.13	0.00	109.95	435.01	581.09	
		+0.95	262.45	3.30	0.00	34.98	300.73		29.23	9.61	102.26	435.02	576.12	
		+0.51	196.40	0.00	13.18	90.76	300.34		20.26	0.00	51.94	249.69	321.89	
		-0.51	0.00	0.00	0.00	53.86	53.86		0.00	0.00	0.00	38.49	38.49	
		Total	2596.42	9.54	13.18	318.75	2937.89	53.86	336.97	108.16	1192.04	2738.57	4375.74	38.49
17	11.74	+5.08	803.11	0.00	0.00	12.35	815.46		29.38	0.00	284.75	162.65	476.78	
		+2.54	887.17	4.35	121.92	34.59	1048.03		78.29	67.45	432.02	161.73	739.49	
		+1.59	109.38	0.00	0.00	15.32	124.70		11.22	0.00	50.03	30.70	91.95	
		+0.95	91.61	1.00	0.00	12.17	104.78		14.92	0.00	17.58	71.66	104.16	
		+0.51	59.44	0.00	1.73	32.13	93.30		6.16	0.32	25.70	23.60	55.78	
		-0.51	0.00	0.00	0.00	63.93	63.93		0.00	0.00	0.00	3.22	3.22	
		Total	1950.71	5.35	123.65	170.49	2250.20	63.93	139.97	67.77	810.08	453.56	1471.38	3.22

(continued)

TYPING GUIDE SHEET

TABLE E-7. (continued)

			Infeed						Heavies					
Run No.	Air setting (m^3/sec)	Screen size	Paper + plastic wt (g)	NonFe wt (g)	Ferrous wt (g)	Other wt (g)	Total wt (g)	14 mesh grit (g)	Paper + plastic wt (g)	NonFe wt (g)	Ferrous wt (g)	Other wt(g)	Total wt(g)	14 mesh grit (g)
13	11.74	+5.08	51.46	0.00	0.00	96.41	147.87		50.33	321.88	46.78	655.29	1074.28	
		+2.54	712.25	16.50	143.91	135.87	1008.53		84.23	50.22	1118.70	489.31	1742.48	
		+1.59	308.39	0.00	0.00	132.74	441.13		374.04	29.42	57.52	739.86	1200.84	
		+0.95	831.22	0.00	0.00	255.58	1086.80		312.80	6.69	18.17	273.59	611.25	
		+0.51	1138.17	0.00	0.00	506.87	1645.04		565.53	0.00	26.14	174.24	765.91	
		-0.51	0.00	0.00	0.00	378.68	378.68		0.00	0.00	0.00	77.98	77.98	
		Total	3041.49	16.50	143.91	1506.15	4708.05	378.68	1386.95	408.21	1267.31	2410.27	5472.74	77.98
15	11.74	+5.08	1343.77	0.00	0.00	27.53	1371.30		0.00	0.00	98.53	210.03	308.56	
		+2.54	1403.43	13.62	0.00	48.37	1465.42		46.39	13.62	299.04	717.40	1076.45	
		+1.59	209.93	0.00	0.00	21.87	231.80		24.30	0.00	32.09	361.95	418.34	
		+0.95	117.70	0.00	0.00	12.32	130.02		38.63	0.68	18.15	150.06	207.52	
		+0.51	97.04	0.41	0.00	23.59	121.04		28.52	0.18	12.33	92.74	133.77	
		-0.51	0.00	0.00	0.00	37.77	37.77		0.00	0.00	0.00	27.08	27.08	
		Total	3171.87	14.03	0.00	171.45	3357.35	37.77	137.84	14.48	466.34	1553.06	2171.72	27.08
16	11.74	+5.08	628.75	0.00	0.00	14.66	643.41		87.46	0.00	183.11	101.18	371.75	
		+2.54	1244.12	6.24	0.00	89.19	1339.55		163.89	98.55	744.78	1479.18	2486.40	
		+1.59	264.70	0.00	0.00	35.30	300.00		36.13	0.00	109.95	435.01	581.09	
		+0.95	262.45	3.30	0.00	34.98	300.73		29.23	9.61	102.26	435.02	576.12	
		+0.51	196.40	0.00	13.18	90.76	300.34		20.26	0.00	51.94	249.69	321.89	
		-0.51	0.00	0.00	0.00	53.86	53.86		0.00	0.00	0.00	38.49	38.49	
		Total	2596.42	9.54	13.18	318.75	2937.89	53.86	336.97	108.16	1192.04	2738.57	4375.74	38.49
17	11.74	+5.08	803.11	0.00	0.00	12.35	815.46		29.38	0.00	284.75	162.65	476.78	
		+2.54	887.17	4.35	121.92	34.59	1048.03		78.29	67.45	432.02	161.73	739.49	
		+1.59	109.38	0.00	0.00	15.32	124.70		11.22	0.00	50.03	30.70	91.95	
		+0.95	91.61	1.00	0.00	12.17	104.78		14.92	0.00	17.58	71.66	104.16	
		+0.51	59.44	0.00	1.73	32.13	93.30		6.16	0.32	25.70	23.60	55.78	
		-0.51	0.00	0.00	0.00	63.93	63.93		0.00	0.00	0.00	3.22	3.22	
		Total	1950.71	5.35	123.65	170.49	2250.20	63.93	139.97	67.77	810.08	453.56	1471.38	3.22

(continued)

TABLE E-7. (concluded)

			Infeed						Heavies					
Run No.	Air setting (m^3/sec)	Screen size	Paper + plastic wt (g)	NonFe wt (g)	Ferrous wt (g)	Other wt (g)	Total wt (g)	14 mesh grit (g)	Paper + plastic wt (g)	NonFe wt (g)	Ferrous wt (g)	Other wt(g)	Total wt(g)	14 mesh grit (g)
18	11.74	+5.08	266.53	0.00	0.00	41.20	307.73		66.52	17.98	155.45	651.47	891.42	
		+2.54	1033.17	8.40	5.81	353.37	1400.75		69.06	103.87	1007.61	868.44	2048.98	
		+1.59	203.62	0.00	0.00	75.37	278.99		68.86	0.00	275.20	305.02	649.08	
		+0.95	289.80	0.00	0.00	130.54	420.34		80.58	6.30	232.84	625.95	945.67	
		+0.51	189.59	6.31	0.00	317.35	513.25		42.19	0.00	48.35	672.82	763.36	
		-0.51	0.00	0.00	0.00	184.28	184.28		0.00	0.00	0.00	100.46	100.46	
		Total	1982.71	14.71	5.81	1102.11	3105.34	184.28	327.21	128.15	1719.45	3224.16	5398.97	100.46
19	11.74	+5.08	174.39	0.00	0.00	95.41	269.80		117.30	0.00	416.48	108.89	642.67	
		+2.54	804.02	8.14	59.75	174.57	1046.48		206.14	45.80	911.22	532.11	1695.27	
		+1.59	225.65	0.00	0.00	25.21	250.86		71.10	100.75	128.41	341.42	641.68	
		+0.95	466.29	1.08	0.00	71.49	538.86		153.78	40.51	33.99	438.98	667.26	
		+0.51	338.06	0.00	0.00	456.27	794.33		38.38	1.63	44.44	494.40	578.85	
		-0.51	0.00	0.00	0.00	251.62	251.62		0.00	0.00	0.00	140.57	140.57	
		Total	2008.41	9.22	59.75	1074.57	3151.95	251.62	586.70	188.69	1534.54	2056.37	4366.30	140.57

TABLE E-8. MOISTURE CONTENT, INITIAL TO AIR DRIED CONDITION--AMES

Run no.	Infeed Initial wt (g)	Infeed Final wt (g)	Infeed Moisture wt (g)	Infeed Moisture Content %	Heavies Initial wt (g)	Heavies Final wt (g)	Heavies Moisture wt (g)	Heavies Moisture Content %
1	4483.25	3546.88	936.37	20.9	5504.75	4540.04	964.71	17.5
2	4823.75	4226.74	597.01	12.4	4086.00	4000.87	85.13	2.1
3	4994.00	4454.87	539.13	10.8	5221.00	4908.87	312.13	6.0
4	6753.25	5646.62	1106.63	16.4	7547.75	6895.13	652.62	8.6
5	3972.50	3660.37	312.13	7.9	5561.50	5249.37	312.13	5.6
6	3291.50	2979.37	312.13	9.5	3461.75	3263.13	198.62	5.7
7	5504.75	4454.87	1049.88	19.1	4937.25	3887.37	1049.88	31.3
9	4653.50	4227.87	425.63	9.1	4086.00	3546.87	539.13	13.2
11	448#.25	4000.87	483.38	10.8	5902.00	5022.37	879.63	14.9
12	5050.75	4681.87	368.88	7.3	10555.50	10044.75	510.75	4.8
13	5902.00	4852.13	1049.87	17.8	6412.75	5646.63	766.12	11.9
15	3944.13	3433.37	510.76	12.9	3178.00	2411.87	766.13	24.1
16	4142.75	2922.63	1220.12	29.4	8115.25	4483.25	3632.00	44.8
17	2553.75	2298.38	255.37	10.0	1702.50	1503.87	198.63	11.7
18	3802.25	3319.87	482.38	12.7	7320.75	5646.63	1674.12	22.9
19	4994.00	3376.63	1617.37	32.4	5958.75	4369.75	1589.00	26.7

TABLE E-9. POWER MEASUREMENTS, AUGUST 1979--AMES

		Air Density Separator					Dust Collection			
Air setting	Main fan	Rotary air lock	Vibratory feeder	Flight Conveyor ADS	Screw feeder RDF	Rotary air lock PSI[a]	Dust receiver fan	Rotary air lock	Fan	Total (kW)
13.32 m^3/sec	110.4	1.4	2.2	4.8	2.0	9.0	5.8	0.85	22.0	158.45
12.70 m^3/sec	106.9	1.4	2.2	4.8	2.0	9.0	5.8	0.85	22.0	154.95
11.74 m^3/sec	97.5	1.4	2.2	4.8	2.0	9.0	5.8	0.85	22.0	145.55

[a] Pneumatic Conveying System.

APPENDIX F

FIELD TEST DATA FOR DUAL VORTEX AIR CLASSIFIER--LOS ANGELES, CALIFORNIA

TABLE F-1. SUMMARY OF OPERATIONAL DATA--LOS ANGELES

Run No.	Input feed rate (Mg/h)	Lights feed rate (Mg/h)	Split percent lights	Air setting (m^3/min)	Ash percent in lights	Ash percent in heavies	Paper + plastic percent in lights	Air Dry Moisture Content Percent in infeed	Paper + plastic percent in heavies	Higher heating Value,[b] kJ/kg Lights	Higher heating Value,[b] kJ/kg Heavies
1	8.45	2.46	29.05	161.11	44.9	63.8	23.47	12.80	16.40	17,515	10,562
2	4.59	2.46	53.56	161.11	23.3	31.3	49.41	7.24	37.89	19,701	17,673
3	4.12	1.56	37.80	161.11							
4	1.43	0.87	60.52	161.11							
5	0.79	0.50	62.83	161.11	26.3	60.2	38.07	7.98	11.44	20,408	12,667
6	0.32	0.19	57.20	161.11	25.0	61.4	35.51	4.54	14.75	18,787	8,627
7	1.70	1.16	68.44	161.11	18.1	47.0	58.43	7.89	22.38		
8	3.47	1.79	51.52	161.11	28.5	21.3	46.37	5.23	20.61		
9	8.06	2.66	33.01	161.11							
10	8.87	5.17	58.32	161.11							
11	2.14	1.83	85.71	299.23	37.9	33.3	25.23	16.46	6.17		
12	1.88	1.80	95.48	299.23	25.0	42.7	17.71	36.24	1.30	20,185	14,821
13	11.85	6.82	57.58	299.23	34.0	40.0	33.75	28.49	16.54		
14	5.90	4.18	70.85	299.23							
15	1.63	1.47	90.03	299.23							
16	8.22	6.15	74.85	299.23	44.7	61.8	27.51	24.28	13.69		
17	1.94	1.73	88.92	299.23							
18	0.56	0.49	86.92	299.23	39.9	75.2	25.86	6.64	1.24	17,738	6,704
19	0.46	0.43	95.05	240.69	22.5	51.8	37.20	2.66	3.67		
20	1.96	1.59	80.93	240.69	41.5	56.8	20.80	12.89	1.75	16,715	4,243
21	1.69	1.32	78.13	240.69							
22	0.42	0.33	79.12	240.69	16.5	48.3	52.77	10.27	2.11	18,936	10.481
23	4.55	4.29	94.11	240.69							
24	5.41	4.31	79.64	240.69	23.1	46.0	34.49	11.33	10.50		
25	5.39	4.02	74.61	240.69							
26	8.81	7.57	89.62	240.69							
27	4.65	4.43	95.25	240.69							
28	5.21	4.93	94.59	240.69	13.8	56.2	46.78	10.23	34.72		

a Oven dried basis.

F-2

TABLE F-2. FEED RATES--LOS ANGELES

			Lights					Heavies					Input
Date 1979	Airflow setting	Run No.	Sample weight (kg)	Tare weight (kg)	Balance weight (kg)	Time (sec)	Feed rate (Mg/h)	Sample weight (kg)	Tare weight (kg)	Balance weight (kg)	Time (sec)	Feed rate (Mg/h)	Feed rate (Mg/h)
12-11	1st Air Setting 161.11 m^3/min (Low)	1	22.73	5.68	17.05	25.00	2.46	47.33	5.68	41.65	25.00	6.00	8.45
		2	21.05	5.68	15.38	22.50	2.46	19.01	5.68	13.34	22.50	2.13	4.59
		3	16.80	5.68	11.12	25.70	1.56	23.98	5.68	18.30	25.70	2.56	4.12
		4	12.94	5.68	7.26	30.20	0.87	10.41	5.68	4.74	30.20	0.56	1.43
		5	9.08	5.68	3.41	24.60	0.50	7.69	5.68	2.01	24.60	0.29	0.79
		6	3.26	0.15	3.11	60.40	0.19	8.00	5.68	2.33	60.40	0.14	0.32
		7	11.35	5.75	5.60	17.30	1.16	8.26	5.68	2.58	17.30	0.54	1.70
		8	17.25	5.68	11.58	23.30	1.79	16.57	5.68	10.90	23.30	1.68	3.47
		9	20.23	5.68	14.56	19.70	2.66	35.21	5.68	29.54	19.70	5.40	8.06
		10	30.53	5.68	24.86	17.30	5.17	23.44	5.68	17.76	17.30	3.70	8.87
12-12	2nd Air Setting 299.23 m^3/min (High)	11	10.61	5.68	4.94	9.70	1.83	6.50	5.68	0.82	9.70	0.31	2.14
		12	11.70	5.68	5.39	10.80	1.80	5.93	5.68	0.26	10.80	0.09	1.88
		13	24.43	5.68	18.76	9.90	6.82	19.49	5.68	13.82	9.90	5.02	11.85
		14	17.05	5.68	11.38	9.80	4.18	10.36	5.68	4.68	9.80	1.72	5.90
		15	12.66	5.68	6.98	17.10	1.47	6.04	5.68	0.37	17.10	0.16	1.63
		16	19.69	5.68	14.02	8.20	6.15	10.39	5.68	4.71	8.20	2.07	8.22
		17	14.56	5.68	8.88	18.50	1.73	6.78	5.68	1.11	18.50	0.22	1.94
		18	8.88	5.68	3.21	23.70	0.49	6.16	5.68	0.48	23.70	0.07	0.56
12-13	3rd Air Setting 240.69 m^3/min (Medium)	19	8.40	5.68	2.72	22.60	0.43	5.82	5.68	0.14	22.60	0.02	0.46
		20	15.55	5.68	9.87	22.40	1.59	8.00	5.68	2.33	22.40	0.37	1.96
		21	13.99	5.68	8.31	22.60	1.32	8.00	5.68	2.33	22.60	0.37	1.69
		22	7.72	5.68	2.04	22.30	0.33	6.21	5.68	0.54	22.30	0.09	0.42
		23	19.72	5.68	14.05	11.80	4.29	6.55	5.68	0.88	11.80	0.27	4.55
		24	19.55	5.68	13.88	11.60	4.31	9.22	5.68	3.55	11.60	1.10	5.41
		25	19.18	5.68	13.51	12.10	4.02	10.27	5.68	4.60	12.10	1.37	5.39
		26	36.35	11.35	25.00	11.90	7.57	8.57	5.68	2.89	8.4	1.24	8.81
		27	25.00	11.35	13.65	11.10	4.43	6.36	5.68	0.68	11.10	0.22	4.65
		28	27.86	11.43	16.44	12.00	4.93	7.26	5.68	1.59	12.00	0.28	5.21

TABLE F-3. LOWEST AIRFLOW--LOS ANGELES

Date: 12-11-79 Baro. press: 28.80 in Hg	Traverse Point	Traverse Location (cm)	Total pressure inlet Δh (in H_2O)	Total pressure outlet Δh (in H_2O)	Pressure drop (in H_2O)	Velocity press. inlet Δh_i (in H_2O)	$\sqrt{\Delta h_i}$	Air density α_A (lb/ft^3)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m^2)	Airflow rate (m^3/min)	Airflow rate (Mg/h)
T_d = 17.78°C (64°F)	1	1.91	-2.50	0.00		0.41	0.64						
T_w = 12.22°C (54°F)	2	5.40	-2.40	0.00		0.56	0.75						
	3	9.84	-2.45	0.00		0.54	0.73						
	4	16.35	-2.60	0.00		0.47	0.69						
	5	33.02	-2.60	0.00		0.45	0.67						
	6	39.69	-2.60	0.00		0.51	0.71						
	7	44.29	-2.50	0.00		0.54	0.73						
	8	47.15	-2.65	0.00		0.43	0.66						
Average			-2.54	0.00	-2.54	0.49	0.70	0.0730	2841.85	866.21	0.186	161.11	11.31

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TABLE F-4. MIDDLE AIRFLOW--LOS ANGELES

Date: 12-12-79 Baro. press: 29.00 in Hg	Traverse		Total pressure		Pressure drop	Velocity press. inlet		Air density	Air velocity	Air velocity	Duct area	Airflow rate	Airflow rate
	Point	Location (cm)	inlet Δh (in H_2O)	outlet Δh (in H_2O)	(in H_2O)	Δh_1 (in H_2O)	$\sqrt{\Delta h_1}$	α_A (lb/ft^3)	(ft/min)	(m/min)	(m^2)	(m^3/min)	(Mg/h)
T_d = 19.44°C (67°F)	1	1.91	-5.75	0.00		0.85	0.92						
T_w = 7.78°C (46°F)	2	5.40	-5.40	0.00		1.35	1.16						
	3	9.84	-5.50	0.00		1.25	1.19						
	4	16.35	-5.70	0.00		1.10	1.05						
	5	33.02	-5.70	0.00		1.15	1.07						
	6	39.69	-5.70	0.00		1.10	1.05						
	7	44.29	-5.70	0.00		1.00	1.00						
	8	47.15	-5.75	0.00		0.72	0.85						
Average			-5.65	0.00	-5.65	1.07	1.04	0.0721	4245.67	1294.10	0.186	240.69	16.71

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TABLE F-5. HIGHEST AIRFLOW--LOS ANGELES

Date: 12-12-79 Baro. press: 29.02 in Hg	Traverse Point	Traverse Location (cm)	Total pressure inlet Δh (in H_2O)	Total pressure outlet Δh (in H_2O)	Pressure drop (in H_2O)	Velocity press. inlet Δh_i (in H_2O)	$\sqrt{\Delta h_i}$	Air density α_A (lb/ft^3)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m^2)	Airflow rate (m^3/min)	Airflow rate (Mg/h)
T_d = 18.33°C (65°F)	1	1.91	-8.90	0.00		1.50	1.22						
T_w = 7.22°C (45°F)	2	5.40	-8.70	0.00		2.25	1.50						
	3	9.84	-8.90	0.00		2.00	1.41						
	4	16.35	-9.20	0.00		1.70	1.30						
	5	33.02	-9.20	0.00		1.55	1.24						
	6	39.69	-9.30	0.00		1.65	1.28						
	7	44.29	-9.30	0.00		1.80	1.34						
	8	47.15	-9.75	0.00		0.98	0.99						
Average			-9.16	0.00	-9.16	1.70	1.33	0.07182	5278.30	1608.84	0.186	299.23	20.68

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TABLE F-6. PARTICLE SIZE DISTRIBUTION--LOS ANGELES

Run No.	Screen size (cm)	Lights: Total weight (g)	Lights: % Retained	Lights: Cumulative % passing	Heavies: Total weight (g)	Heavies: % Retained	Heavies: Cumulative % passing
1	+5.08	216.20	5.50	94.50	36.87	1.59	98.41
	+2.54	469.59	11.95	82.55	153.03	6.60	91.81
	+1.59	75.17	1.91	80.64	52.18	2.25	89.56
	+0.95	156.45	3.98	76.66	234.21	10.10	79.46
	+0.13	839.49	21.35	55.31	1070.96	46.18	33.29
	-0.13	2174.22	55.31		772.06	33.29	
	Total	3931.12			2319.31		
2	+5.08	120.99	6.09	93.91	166.52	5.92	94.08
	+2.54	378.48	19.06	74.85	643.05	22.88	71.20
	+1.59	186.43	9.39	65.46	267.18	9.50	61.70
	+0.95	172.29	8.67	56.79	460.39	16.38	45.32
	+0.13	458.50	23.08	33.71	854.48	30.40	14.92
	-0.13	669.48	33.71		419.06	14.91	
	Total	1986.17			2810.68		
5	+5.08	103.35	3.34	96.66	78.70	4.28	95.72
	+2.54	331.36	10.73	85.93	309.97	16.84	78.88
	+1.59	231.13	7.48	78.45	129.11	7.01	71.87
	+0.95	266.24	8.62	69.83	188.16	10.22	61.65
	+0.13	691.95	22.40	47.43	781.26	42.44	19.21
	-0.13	1465.11	47.43		353.39	19.21	
	Total	3089.14			1840.59		
6	+5.08	192.88	7.62	92.38	291.15	15.42	84.58
	+2.54	326.75	12.90	79.48	233.64	12.37	72.21
	+1.59	80.60	3.18	76.30	174.16	9.22	62.99
	+0.95	185.10	7.31	68.99	293.10	15.52	47.47
	+0.13	681.61	26.92	42.07	761.62	40.33	7.14
	-0.13	1065.42	42.07		134.84	7.14	
	Total	2532.36			1888.51		

(continued)

TABLE F-6. (continued)

		Lights			Heavies		
Run No.	Screen size (cm)	Total weight (g)	% Retained	Cumulative % passing	Total weight (g)	% Retained	Cumulative % passing
7	+5.08	367.29	14.88	85.12	330.46	14.63	85.37
	+2.54	566.02	22.94	62.18	520.14	23.03	62.34
	+1.95	147.44	5.98	56.20	125.79	5.57	56.77
	+0.95	292.62	11.86	44.34	219.98	9.74	47.03
	+0.13	529.63	21.46	22.88	699.03	30.95	16.08
	-0.13	564.61	22.88		363.24	16.08	
	Total	2467.61			2258.64		
8	+5.08	287.35	12.58	87.42	116.25	3.35	96.65
	+2.54	440.37	19.29	68.13	596.35	17.19	79.46
	+1.95	85.57	3.75	64.38	280.85	8.10	71.36
	+0.95	174.08	7.67	56.76	371.95	10.72	60.64
	+0.13	550.58	24.11	32.64	1409.18	40.63	20.01
	-0.13	745.22	32.64		694.01	20.01	
	Total	2283.17			3468.59		
11	+5.08	63.37	3.35	96.65	35.99	10.67	89.33
	+2.54	184.79	9.78	86.87	28.42	8.42	80.91
	+1.95	70.85	3.75	83.12	39.30	11.65	69.26
	+0.95	196.82	10.42	72.70	65.58	19.44	49.82
	+0.13	671.08	35.51	37.19	164.19	48.67	1.14
	-0.13	702.68	37.19		3.86	1.14	
	Total	1889.59			337.34		
12	+5.08	80.76	4.25	95.75	0.00	0.00	100.00
	+2.54	190.14	10.00	85.75	11.56	6.70	93.30
	+1.95	55.92	2.94	82.81	8.35	4.84	88.46
	+0.95	180.77	9.51	73.30	30.30	17.56	70.90
	+0.13	960.40	50.51	22.79	104.26	60.40	10.50
	-0.13	433.48	22.79		18.13	10.50	
	Total	1901.47			172.60		

(continued)

TABLE F-6. (continued)

		Lights			Heavies		
Run No.	Screen size (cm)	Total weight (g)	% Retained	Cumulative % passing	Total weight (g)	% Retained	Cumulative % passing
13	+5.08	173.38	10.05	89.95	59.21	2.57	97.43
	+2.54	305.27	17.70	72.75	253.98	11.02	86.41
	+1.59	111.53	6.46	65.79	151.63	6.58	79.83
	+0.95	215.69	12.50	53.29	218.40	9.48	70.35
	+0.13	628.78	36.45	16.84	1161.60	50.40	19.95
	-0.13	290.45	16.84		459.78	19.95	
	Total	1725.10			2304.60		
16	+5.08	70.51	3.12	96.88	786.63	20.67	79.33
	+2.54	474.91	21.02	75.86	422.00	11.09	68.24
	+1.59	70.27	3.11	72.75	257.04	6.76	61.48
	+0.95	179.88	7.96	64.79	417.91	10.98	50.50
	+0.13	841.73	37.26	27.52	1422.78	37.39	13.11
	-0.13	621.69	27.52		498.39	13.10	
	Total	2258.99			3804.75		
18	+5.08	113.93	3.82	96.18	33.06	8.35	91.65
	+2.54	281.08	9.43	86.75	61.12	15.44	76.21
	+1.59	81.24	2.73	84.02	89.24	22.54	53.67
	+0.95	238.82	8.02	76.00	65.02	16.42	37.25
	+0.13	890.00	29.87	46.13	143.77	36.32	0.93
	-0.13	1374.23	46.13		3.64	0.92	
	Total	2979.30			395.85		
19	+5.08	684.49	24.10	75.90	0.00	0.00	100.00
	+2.54	418.96	14.75	61.15	39.78	27.58	72.42
	+1.59	59.92	2.11	59.04	22.71	15.75	56.67
	+0.95	134.46	4.73	54.31	20.46	14.18	42.49
	+0.13	1190.67	41.92	12.39	59.72	41.41	1.08
	-0.13	351.85	12.39		1.55	1.07	
	Total	2840.35			144.22		

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TABLE F-6. (concluded)

Run No.	Screen size (cm)	Lights: Total weight (g)	Lights: % Retained	Lights: Cumulative % passing	Heavies: Total weight (g)	Heavies: % Retained	Heavies: Cumulative % passing
20	+5.08	254.98	13.06	86.94	129.62	6.11	93.89
	+2.54	168.82	8.65	78.29	397.19	18.72	75.17
	+1.59	58.73	3.01	75.28	196.90	9.28	65.89
	+0.95	111.53	5.72	69.56	442.41	20.85	45.04
	+0.13	557.49	28.57	40.99	902.96	42.56	2.48
	-0.13	799.97	40.99		52.46	2.47	
	Total	1951.51			2121.54		
22	+5.08	218.14	11.93	88.07	86.08	18.10	81.90
	+2.54	295.17	16.15	71.92	135.09	28.40	53.50
	+1.59	165.45	9.05	62.87	69.47	14.61	38.89
	+0.95	290.22	15.88	46.99	86.13	18.12	20.77
	+0.13	541.67	29.63	17.36	97.42	20.48	0.29
	-0.13	317.25	17.36		1.42	0.30	
	Total	1827.90			475.61		
24	+5.08	180.74	9.80	90.20	159.40	5.56	94.44
	+2.54	328.38	17.80	72.40	450.81	15.74	78.70
	+1.59	103.72	5.62	66.78	193.84	6.77	71.93
	+0.95	166.12	9.00	57.78	472.89	16.51	55.42
	+0.13	573.15	31.06	26.72	1145.07	39.98	15.44
	-0.13	492.92	26.72		442.29	15.44	
	Total	1845.02			2864.30		
28	+5.08	182.04	13.24	86.76	234.05	21.72	78.28
	+2.54	493.27	35.88	50.88	220.73	20.49	57.79
	+1.59	119.30	8.68	42.20	85.96	7.98	49.81
	+0.95	179.28	13.04	29.16	95.04	8.82	40.99
	+0.13	263.10	19.14	10.02	340.94	31.64	9.35
	-0.13	137.80	10.02		100.71	9.35	
	Total	1374.79			1077.43		

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F-7

TABLE F-7. SAMPLE COMPOSITION--LOS ANGELES

			Lights						Heavies					
Run No.	Air setting (ft^3/min)	Screen size (cm)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh* grit (g)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh* grit (g)
1	5689.55	+5.08	194.84	0.00	0.00	21.36	216.20		36.87	0.00	0.00	0.00	36.87	
	5689.55	+2.54	437.51	10.37	0.00	21.71	469.59		136.65	0.99	0.00	15.39	153.03	
	5689.55	+1.59	67.33	3.88	0.00	3.96	75.17		40.02	2.30	0.00	9.85	52.18	
	5689.55	+0.95	126.66	5.72	0.00	24.07	156.45		66.27	2.28	15.76	149.90	234.21	
	5689.55	+0.13	96.60	14.64	0.00	728.25	839.49		100.57	2.16	0.00	968.22	1070.96	
	5689.55	-0.13	0.00	0.00	0.00	2174.22	2174.22		0.00	0.00	0.00	772.06	772.06	
	5689.55	Total	922.94	34.61	0.00	2973.57	3931.12	2174.22	380.38	7.73	15.76	1915.42	2319.31	772.06
2	5689.55	+5.08	119.83	0.00	0.00	1.16	120.99		149.75	0.00	0.00	16.77	166.52	
	5689.55	+2.54	363.74	1.86	8.65	4.23	378.48		321.11	3.46	239.10	79.38	643.05	
	5689.55	+1.59	172.13	1.99	0.00	12.31	186.43		124.52	2.94	24.10	115.54	267.18	
	5689.55	+0.95	149.94	0.36	0.00	21.99	172.29		264.56	1.04	14.28	200.52	460.39	
	5689.55	+0.13	102.44	0.10	0.00	355.96	458.50		225.06	0.00	0.00	629.41	854.68	
	5689.55	-0.13	73.26	0.00	0.00	596.22	669.48		0.00	0.00	0.00	419.06	419.06	
	5689.55	Total	981.34	4.31	8.65	991.87	1986.17	669.48	1085.00	7.44	277.56	1460.68	2810.68	419.06
5	5689.55	+5.08	102.95	0.00	0.00	0.40	103.35		6.05	0.00	72.65	0.00	78.70	
	5689.55	+2.54	302.24	2.03	0.00	27.09	331.36		73.69	11.96	174.15	50.17	309.97	
	5689.55	+1.59	215.87	3.76	0.00	11.50	231.13		38.50	4.35	14.63	71.63	129.11	
	5689.55	+0.95	251.60	2.36	0.00	12.29	266.25		60.21	3.78	13.47	110.70	188.16	
	5689.55	+0.13	303.39	2.54	0.00	386.02	691.95		32.18	0.92	8.79	739.37	781.26	
	5689.55	-0.13	0.00	0.00	0.00	1465.11	1465.11		0.00	0.00	0.00	353.39	353.39	
	5689.55	Total	1176.05	10.69	0.00	1902.41	3089.16	1465.11	210.63	21.01	283.69	1325.26	1840.59	353.39
6	5689.55	+5.08	171.28	20.38	0.00	1.22	192.88		120.26	0.00	152.64	18.27	291.15	
	5689.55	+2.54	304.99	4.00	0.00	17.76	326.75		67.28	41.99	66.53	57.84	233.64	
	5689.55	+1.59	55.99	2.69	0.00	21.92	80.60		12.32	4.24	5.40	152.20	174.16	
	5689.55	+0.95	164.70	1.43	0.00	18.97	185.10		40.53	5.05	7.24	240.28	293.10	
	5689.55	+0.13	202.30	0.00	0.00	479.31	681.61		38.23	1.29	17.03	705.07	761.62	
	5689.55	-0.13	0.00	0.00	0.00	1065.42	1065.42		0.00	0.00	0.00	134.84	134.84	
	5689.55	Total	899.26	28.50	0.00	1604.60	2532.36	1065.42	278.60	52.57	248.84	1308.50	1888.51	134.84

(continued)

F-7

TABLE F-7. (continued)

			Lights						Heavies					
Run No.	Air setting (ft^3/min)	Screen size (cm)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh* grit (g)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh* grit (g)
7	5689.55	+5.08	295.54	0.00	0.00	71.75	367.29		82.69	0.00	189.24	58.53	330.46	
	5689.55	+2.54	547.61	2.90	0.00	15.51	566.02		201.82	17.23	239.69	61.40	520.14	
	5689.55	+1.59	125.18	6.96	0.00	15.30	147.44		50.40	2.77	19.86	52.76	125.79	
	5689.55	+0.95	251.86	4.20	6.59	29.97	292.62		106.61	2.48	6.86	104.03	219.98	
	5689.55	+0.13	221.52	10.89	0.00	297.22	529.63		63.93	2.92	39.42	592.76	699.03	
	5689.55	-0.13	0.00	0.00	0.00	564.61	564.61		0.00	0.00	0.00	363.24	363.24	
	5689.55	Total	1441.71	24.95	6.59	994.36	2467.61	564.61	505.45	25.40	495.07	1232.72	2258.64	363.24
8	5689.55	+5.08	272.47	9.81	0.00	5.07	287.35		79.19	0.00	35.58	1.48	116.25	
	5689.55	+2.54	432.58	0.00	0.00	7.79	440.37		312.32	1.74	102.76	179.53	596.35	
	5689.55	+1.59	81.94	3.63	0.00	0.00	85.57		111.69	0.00	13.19	155.97	280.85	
	5689.55	+0.95	153.20	1.61	0.00	19.27	174.08		117.31	3.74	5.79	245.11	371.95	
	5689.55	+0.13	118.46	0.00	0.00	432.12	550.58		94.33	4.59	8.73	1301.53	1409.18	
	5689.55	-0.13	0.00	0.00	0.00	745.22	745.22		0.00	0.00	0.00	694.01	694.01	
	5689.55	Total	1058.65	15.05	0.00	1209.47	2283.17	745.22	714.84	10.07	166.05	2577.63	3468.59	694.01
11	10,567.21	+5.08	49.54	3.10	0.00	10.73	63.37		0.00	0.00	35.99	0.00	35.99	
	10,567.21	+2.54	144.83	12.63	0.00	27.33	184.79		3.01	4.26	5.42	15.65	28.42	
	10,567.21	+1.59	62.82	0.00	0.00	8.03	70.85		8.11	2.19	0.00	29.00	39.30	
	10,567.21	+0.95	124.69	2.23	0.00	69.90	196.82		6.01	0.00	2.75	56.82	65.58	
	10,567.21	+0.13	94.78	6.83	1.20	568.27	671.08		3.60	10.13	9.11	141.35	164.19	
	10,567.21	-0.13	0.00	0.00	0.00	702.68	702.68		0.00	0.00	0.00	3.86	3.86	
	10,567.21	Total	476.66	24.79	1.20	1386.94	1889.59	702.68	20.81	16.58	53.27	246.68	337.34	3.86
12	10,567.21	+5.08	61.34	7.14	0.00	12.28	80.76		0.00	0.00	0.00	0.00	0.00	
	10,567.21	+2.54	111.97	0.00	0.00	78.17	190.14		0.58	0.00	0.00	10.98	11.56	
	10,567.21	+1.59	31.94	0.00	0.00	23.98	55.92		0.57	1.89	2.11	3.78	8.35	
	10,567.21	+0.95	72.50	0.00	0.00	108.27	180.77		0.57	0.00	4.18	25.55	30.30	
	10,567.21	+0.13	59.06	0.00	0.00	901.34	960.40		0.53	0.13	1.50	102.10	104.26	
	10,567.21	-0.13	0.00	0.00	0.00	433.48	433.48		0.00	0.00	0.00	18.13	18.13	
	10,567.21	Total	336.81	7.14	0.00	1557.52	1901.47	433.48	2.25	2.02	7.79	160.54	172.60	18.13

(continued)

F-7

TABLE F-7. (continued)

			Lights						Heavies					
Run No.	Air setting (ft^3/min)	Screen size (cm)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh* grit (g)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh* grit (g)
13	10,567.21	+5.08	103.52	0.00	0.00	69.86	173.38		21.10	0.00	0.00	38.11	59.21	
	10,567.21	+2.54	209.08	3.86	16.48	75.85	305.27		114.44	10.18	29.72	99.64	253.98	
	10,567.21	+1.59	71.20	10.72	0.00	29.61	111.53		50.94	27.53	26.53	46.63	151.63	
	10,567.21	+0.95	148.25	0.56	0.00	66.89	215.69		113.01	7.26	0.00	98.13	218.40	
	10,567.21	+0.13	50.24	0.00	12.68	565.85	628.78		81.60	0.40	0.00	1079.60	1161.60	
	10,567.21	-0.13	0.00	0.00	0.00	290.45	290.45		0.00	0.00	0.00	459.78	459.78	
	10,567.21	Total	582.29	15.14	29.16	1098.51	1725.10	290.45	381.09	45.37	56.25	1821.89	2304.60	459.78
16	10,567.21	+5.08	43.44	20.11	0.00	6.96	70.51		74.01	0.00	712.62	0.00	786.63	
	10,567.21	+2.54	372.95	26.76	46.37	28.83	474.91		185.21	5.80	154.30	76.69	422.00	
	10,567.21	+1.59	51.92	1.48	0.00	16.87	70.27		70.18	0.00	20.58	166.28	257.04	
	10,567.21	+0.95	118.36	2.18	16.87	42.47	179.88		100.36	27.49	0.00	290.06	417.91	
	10,567.21	+0.13	34.84	0.79	0.00	806.10	841.73		91.14	2.78	0.00	1328.86	1422.78	
	10,567.21	-0.13	0.00	0.00	0.00	621.69	621.69		0.00	0.00	0.00	498.39	498.39	
	10,567.21	Total	621.51	51.32	63.24	1522.92	2258.99	621.69	520.90	36.07	887.50	2360.28	3804.75	498.39
18	10,567.21	+5.08	111.84	0.00	0.00	2.09	113.93		0.00	0.00	7.62	25.44	33.06	
	10,567.21	+2.54	259.07	3.22	9.12	9.67	281.08		0.00	4.05	50.01	7.06	61.12	
	10,567.21	+1.59	71.08	0.00	0.00	10.16	81.24		0.00	0.00	26.05	63.19	89.24	
	10,567.21	+0.95	178.31	0.84	0.00	59.67	238.82		3.75	2.99	10.03	48.25	65.02	
	10,567.21	+0.13	150.00	6.19	0.00	733.81	890.00		1.14	0.58	15.26	126.79	143.77	
	10,567.21	-0.13	0.00	0.00	0.00	1374.23	1374.23		0.00	0.00	0.00	3.64	3.64	
	10,567.21	Total	770.30	10.25	9.12	2189.63	2979.30	1374.23	4.89	7.62	108.97	274.37	395.85	3.64
19	8,499.87	+5.08	119.96	0.00	6.64	557.89	684.49		0.00	0.00	0.00	0.00	0.00	
	8,499.87	+2.54	366.62	32.75	8.66	10.93	418.96		0.36	0.00	38.31	1.11	39.78	
	8,499.87	+1.59	54.62	1.24	0.00	4.06	59.92		0.00	0.00	11.88	10.83	22.71	
	8,499.87	+0.95	122.66	0.00	0.00	11.80	134.46		1.67	1.36	2.00	15.43	20.46	
	8,499.87	+0.13	392.67	12.00	0.00	786.00	1190.67		3.26	2.37	3.37	50.72	59.72	
	8,499.87	-0.13	0.00	0.00	0.00	351.85	351.85		0.00	0.00	0.00	1.55	1.55	
	8,499.87	Total	1056.53	45.99	15.30	1722.53	2840.35	351.85	5.29	3.73	55.56	79.64	144.22	1.55

(continued)

F-7

TABLE F-7. (concluded)

			Lights						Heavies					
Run No.	Air setting (ft³/min)	Screen size (cm)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh* grit (g)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh* grit (g)
20	8,499.81	+5.08	52.63	3.62	0.00	198.73	254.98		0.00	0.00	101.38	28.24	129.62	
	8,499.81	+2.54	142.14	3.95	0.00	22.73	168.82		19.37	18.36	242.13	117.33	397.19	
	8,499.81	+1.59	44.70	3.49	0.00	10.54	58.73		3.34	6.96	24.38	162.22	196.90	
	8,499.81	+0.95	75.53	0.33	0.00	35.67	111.53		8.56	38.69	98.28	296.88	442.41	
	8,499.81	+0.13	90.89	0.00	0.00	466.60	557.49		5.92	19.85	54.56	822.63	902.96	
	8,499.81	+0.13	0.00	0.00	0.00	799.97	799.97		0.00	0.00	0.00	52.46	52.46	
	8,499.81	Total	405.89	7.77	3.62	1534.24	1951.52	799.97	37.19	83.86	520.73	1479.76	2121.54	52.46
22	8,499.81	+5.08	90.56	0.00	0.00	127.58	218.14		0.00	0.00	55.13	30.95	86.08	
	8,499.81	+2.54	265.23	0.53	0.00	29.41	295.17		0.00	0.00	70.75	64.34	135.09	
	8,499.81	+1.59	153.79	6.02	0.00	5.64	165.45		7.24	0.00	32.02	30.21	69.47	
	8,499.81	+0.95	242.90	0.83	0.00	46.49	290.22		0.07	0.65	16.62	68.79	86.13	
	8,499.81	+0.13	212.04	0.00	0.00	329.63	541.67		2.74	0.00	7.69	86.99	97.42	
	8,499.81	-0.13	0.00	0.00	0.00	317.25	317.25		0.00	0.00	0.00	1.42	1.42	
	8,499.81	Total	964.52	7.38	0.00	856.00	1827.90	317.25	10.05	0.65	182.21	282.70	475.61	1.42
24	8,499.81	+5.08	114.84	0.00	0.00	65.90	180.74		33.53	0.00	8.67	117.20	159.40	
	8,499.81	+2.54	252.08	11.26	6.84	58.20	328.38		113.28	20.41	86.65	230.47	450.81	
	8,499.81	+1.59	54.00	5.60	0.00	44.12	103.72		49.30	0.00	0.00	144.54	193.84	
	8,499.81	+0.95	101.84	1.18	0.00	63.10	166.12		76.78	1.02	31.15	363.94	472.89	
	8,499.81	+0.13	113.62	0.00	0.00	459.53	573.15		27.97	4.63	0.00	1112.47	1145.07	
	8,499.81	-0.13	0.00	0.00	0.00	492.92	492.92		0.00	0.00	0.00	442.29	442.29	
	8,499.81	Total	636.38	18.04	6.84	1183.77	1845.03	492.92	300.86	26.06	126.47	2410.91	2864.30	442.29
28	8,499.81	+5.08	154.08	0.00	0.00	27.96	182.04		47.94	13.62	168.17	4.32	234.05	
	8,499.81	+2.54	350.22	9.92	6.70	126.43	493.27		85.63	10.65	115.51	8.94	220.73	
	8,499.81	+1.59	43.31	0.00	0.00	75.99	119.30		36.63	41.05	0.00	8.28	85.96	
	8,499.81	+0.95	75.79	0.81	2.42	100.26	179.28		59.84	10.27	10.74	14.19	95.04	
	8,499.81	+0.13	19.65	0.00	0.00	243.35	263.10		144.03	3.36	59.46	134.09	340.94	
	8,499.81	-0.13	0.00	0.00	0.00	137.80	137.80		0.00	0.00	0.00	100.71	100.71	
	8,499.81	Total	643.15	10.73	9.12	711.79	1374.79	137.80	374.07	78.95	353.88	270.53	1077.43	100.71

* Weight that passes 0.13 cm screen size is given here as 14 Mesh grit.

TABLE F-8. MOISTURE CONTENT, INITIAL TO AIR DRIED CONDITION--LOS ANGELES

	Lights				Heavies			
Run no.	Initial Weight (g)	Final Weight (g)	Moisture Weight (g)	Moisture Content (%)	Initial Weight (g)	Final Weight (g)	Moisture Weight (g)	Moisture Content (%)
1	4540.00	3958.88	581.12	12.80	2724.00	2340.94	383.06	14.06
2	2156.50	2000.44	156.06	7.24	3178.00	2823.31	354.69	11.16
5	3376.62	3107.06	269.56	7.98	2014.62	1858.56	156.06	7.75
6	2809.12	2681.44	127.68	4.54	2298.38	1943.69	354.69	15.43
7	2695.62	2482.81	212.81	7.89	2553.75	2284.19	269.56	10.56
8	2440.25	2312.56	127.69	5.23	3688.75	3504.31	184.44	5.00
11	2326.75	1943.69	383.06	16.46	794.50	751.94	42.56	5.36
12	3092.88	1972.06	1120.82	36.24	255.38	184.44	70.94	27.78
13	2440.25	1745.06	695.19	28.49	3376.62	2312.56	1064.06	31.51
16	2979.38	2255.81	723.57	24.28	4681.88	3816.44	865.44	18.48
18	3206.38	2993.56	212.82	6.64	454.00	411.44	42.56	9.37
19	2667.25	2596.31	70.94	2.66	170.25	156.06	14.19	8.33
20	3405.00	2965.19	439.81	12.89	2355.13	2142.31	212.82	9.04
22	2071.38	1858.56	212.82	10.27	567.50	496.56	70.94	12.05
24	2128.12	1886.94	241.18	11.33	3575.25	2936.81	638.44	17.86
28	1248.50	1120.81	127.69	10.23	1617.38	1376.19	241.19	14.91

TABLE F-9. POWER MEASUREMENTS--LOS ANGELES

Air setting	Fan (kW)	Feed air lock (kW)	Cyclone air lock (kW)	Total (kW)
Low airflow 161.11 m^3/min	21.0	0.3	1.6	22.9
High airflow 299.23 m^3/min	24.5	0.2	1.4	26.1
Middle airflow 240.69 m^3/min	24.8	0.2	1.6	26.4

EPA Form 2250-6 (4-80)
TYPING GUIDE SHEET

APPENDIX G

FIELD TEST DATA FOR VIBRATING FLUIDIZED BED AIR CLASSIFIER--AKRON, OHIO

TABLE G-1. SUMMARY OF OPERATIONAL DATA--AKRON

Run No.	Input feed rate (Mg/h)	Lights feed rate (Mg/h)	Split percent lights	Air setting (m^3/min)	Ash percent in lights	Ash percent in heavies	Paper + plastic percent in lights	Air Dry Moisture Air Dry % Moisture		Paper + plastic percent in heavies	Higher heating Value,[b] kJ/kg	
								Lights	Heavies		Lights	Heavies
1	32.50	27.49	84.41	1721.75	22.8	82.9	69.4	18.1	7.8	3.6	14,289	3,498
2	40.99	34.65	84.54	1721.75	26.1	62.5	50.2	20.7	6.6	4.4	17,608	6,604
3	58.00	21.68	37.39	1721.75	19.7	50.9	70.1	19.8	17.3	31.4		
4	47.49	13.72	28.90	1721.75	-	-	-	-	-	-		
5	84.55	19.03	22.51	1721.75	-	-	-	-	-	-		
6	53.56	34.57	64.54	1721.75	25.00	41.5	55.8	21.7	17.8	21.7	13,430	349
7	1.75	1.69	96.53	1721.75	26.6	98.2	59.6	16.5	0.0	0.1	15,298	9,437
8	84.66	29.69	35.06	1552.52	24.4	44.4	62.6	19.1	24.0	36.6	16,119	6,978
9	10.41	8.30	79.76	1552.52	24.7	62.5	51.9	20.3	7.1	0.7		
10	6.84	6.43	93.92	1552.52	35.5	63.6	52.3	15.4	6.3	3.2		
11	31.00	27.98	90.27	1552.52	14.3	80.8	62.8	19.9	9.9	3.4		
12	19.17	18.10	94.45	1552.52	20.1	68.6	49.9	20.3	16.0	41.7	15,707	5,815
13	54.74	33.63	61.43	1552.52	32.1	46.5	64.4	22.5	18.4	37.4	13,856	11,651
14	35.38	18.50	52.30	1820.84	-	-	-	-	-	-		
15	7.68	7.36	95.93	1820.84	31.7	64.8	36.9	23.1	19.0	1.4	12,302	4,475
16	31.88	23.96	75.15	1820.84	22.5	55.5	62.7	11.9	18.4	9.8		
17	57.97	24.92	42.99	1820.84	17.7	48.7	73.7	17.2	19.2	41.9		
18	18.47	17.66	95.60	1820.84	23.1	98.0	58.4	2.6	17.9	0.5		
19	1.67	1.64	98.09	1820.84	11.0	99.6	73.4	14.3	10.0	0.1	16,384	70

[a] Oven dried basis.

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TABLE G-2. FEED RATES--AKRON

			Lights						Heavies						Input
Date 1980	Airflow setting m^3/min	Run No.	Sample weight (kg)	Tare weight (kg)	Balance weight (kg)	Sample length (m)	Belt speed (m/min)	Feed rate (Mg/h)	Sample weight (kg)	Tare weight (kg)	Balance weight (kg)	Sample length (m)	Belt speed (m/min)	Feed rate (Mg/h)	Feed rate (Mg/h)
4-8	1721.75	1	23.57	0.20	23.36	13	255	27.49	3.45	0.13	3.32	10	255	5.08	32.57
4-8	1721.75	2	25.17	0.26	24.90	11	255	34.65	4.27	0.13	4.14	10	255	6.34	40.99
4-8	1721.75	3	18.63	0.20	18.43	13	255	21.68	9.56	0.07	9.49	4	255	36.32	58.00
4-8	1721.75	4	11.79	0.13	11.66	13	255	13.72	8.90	0.07	8.83	4	255	37.77	47.49
4-8	1721.75	5	16.30	0.13	16.17	13	255	19.03	17.20	0.07	17.13	4	255	65.51	84.55
4-8	1721.75	6	20.47	0.13	20.34	9	255	34.57	5.09	0.13	4.97	4	255	18.99	53.56
4-8	1721.75	7	3.22	0.13	3.09	28	255	1.69	0.27	0.13	0.13	34	255	0.06	1.75
4-10	1552.52	8	13.75	0.14	13.61	7	255	26.69	11.07	0.07	11.00	3	255	54.98	84.66
4-10	1552.52	9	7.26	0.07	7.19	13	255	8.30	1.45	0.07	1.38	10	255	2.11	10.41
4-10	1552.52	10	6.50	0.07	6.43	15	255	6.43	0.72	0.07	0.65	24	255	0.42	6.84
4-10	1552.52	11	13.04	0.21	12.83	7	255	27.98	2.04	0.07	1.97	10	255	3.02	31.00
4-10	1552.52	12	8.44	0.14	8.30	7	255	18.10	0.77	0.07	0.70	10	255	1.06	19.17
4-10	1552.52	13	15.55	0.14	15.41	7	255	33.63	5.59	0.07	5.52	4	255	21.11	54.74
4-10	1820.84	14	11.04	0.14	10.89	9	255	18.50	4.48	0.07	4.41	4	255	16.88	35.38
4-10	1820.84	15	8.25	0.07	8.18	17	255	7.36	0.77	0.07	0.70	34	255	0.31	7.68
4-10	1820.84	16	11.12	0.14	10.98	7	255	23.96	5.25	0.07	5.18	10	255	7.92	31.88
4-10	1820.84	17	15.56	0.14	11.42	7	255	24.92	8.71	0.07	8.64	4	255	33.05	57.97
4-10	1820.84	18	8.24	0.14	8.09	7	255	17.66	1.14	0.07	1.06	20	255	0.81	18.47
4-10	1820.84	19	1.89	0.07	1.82	17	255	1.64	0.14	0.07	0.07	34	255	0.03	1.67

TABLE G-3. AIRFLOW, LOWEST--AKRON

Date: 4/10/80 Baro. press: 28.58 in Hg	Point	Traverse location (cm)	Total pressure Inlet Δ_h (in H_2O)[b]	Total pressure Outlet Δ_h (in H_2O)[b]	Pressure drop (in H_2O)	Velocity pressure inlet Δ_{hi} (in H_2O)	$\sqrt{\Delta_{hi}}$	Air density σ_A (lb/ft^3)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m^2)	Airflow rate (m^3/min)	Airflow rate (Mg/h)
						Air Classifier Plenum							
T_D = 13.9°C (57°F)	1	5.1	0.00[a]	-	-	1.40	1.18						
T_W = 13.9°C (57°F)	2	10.2	0.00	-	-	1.70	1.30						
	3	15.2	0.00	-	-	1.65	1.28						
	4	25.4	0.00	-	-	1.60	1.26						
	5	35.6	0.00	-	-	1.70	1.30						
	6	45.7	0.00	-	-	1.50	1.22						
Average							1.26	0.0740	4156.64	1266.64	1.23	1552.52	110.45
						Air Classifier Heavies Chute							
T_D = 13.9°C (57°F)	1	7.6	0.00[a]	0.00[a]	0.00	0.70	0.84						
T_W = 13.9°C (57°F)	2	15.2	0.00	0.00	0.00	0.80	0.89						
	3	22.9	0.00	0.00	0.00	0.97	0.98						
Average							0.90	0.0740	3127.87	953.38	1.11	1062.87	75.61
						Material Handling Duct							
	1	2.7	-	+4.2	-	3.2/3.3[b]	1.79/1.82[b]						
T_D = 16.7°C (62°F)	2	8.5	-	+3.2	-	4.7/5.1	2.17/2.26						
T_W = 13.9°C (57°F)	3	15.4	-	+2.5	-	5.0/4.9	2.24/2.21						
	4	23.4	-	+3.1	-	5.0/5.9	2.24/2.43						
	5	35.5	-	+3.2	-	4.7/4.7	2.17/2.17						
	6	68.3	-	+3.2	-	4.9/4.8	2.21/2.19						
	7	80.3	-	+3.1	-	5.1/5.0	2.26/2.24						
	8	88.6	-	+4.0	-	4.4/4.9	2.10/2.21						
	9	95.3	-	+3.6	-	4.1/4.5	2.02/2.12						
	10	101.0	-	+4.0	-	3.6/3.9	1.9/1.97						
Average				+3.41	-		2.14	0.0740	7059.03	2151.62	0.85	1819.02	129.43

[a] Values estimated.

[b] First value measured as pitot tube was inserted and second made as pitot tube was withdrawn.

TABLE G-4. AIRFLOW, MIDDLE--AKRON

Date: 4/10/80	Point	Traverse location (cm)	Total pressure		Pressure drop (in H_2O)	Velocity pressure inlet Δ_{hi} (in H_2O)	Δ_{hi}	Air density σ_A (lb/ft^3)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m^2)	Airflow rate (m^3/min)	Airflow rate (Mg/h)
			Inlet Δ_h (in H_2O)	Outlet Δ_h (in H_2O)									
						Air Classifier Plenum							
Baro. press: 28.52 in Hg	1	5.1	0.00[a]	-	-	1.60	1.26						
T_D = (61°F)	2	10.2	0.00	-	-	2.00	1.41						
T_W = (56°F)	3	15.2	0.00	-	-	2.05	1.43						
	4	25.4	0.00	-	-	1.90	1.38						
	5	35.6	0.00	-	-	1.95	1.40						
	6	45.7	0.00	-	-	2.05	1.43						
Average							1.39	0.0732	4609.72	1405.06	1.23	1721.75	121.20
						Air Classifier Heavies Chute							
	1	7.6	0.00[a]	0.00[a]	0.00	0.78	0.88						
	2	15.6	0.00	0.00	0.00	1.00	1.00						
	3	22.9	0.00	0.00	0.00	1.50	1.22						
Average							1.03	0.0733	4338.24	1322.31	1.11	1474.16	104.00
						Material Handling Duct							
Baro. press: 28.50 in Hg	1	2.7	-	+3.2	-	3.1/3.3	1.76/1.88						
T_D = (61°F)	2	8.5	-	+3.2	-	4.7/4.1	2.17/2.02						
T_W = (58°F)	3	15.4	-	+3.0	-	5.2/4.5	2.28/2.12						
	4	23.4	-	+2.5	-	4.9/4.8	2.21/2.19						
	5	35.5	-	+2.5	-	4.4/4.3	2.10/2.07						
	6	68.3	-	+3.7	-	5.0/4.7	2.24/2.17						
	7	80.3	-	+3.8	-	5.3/5.1	2.30/2.26						
	8	88.6	-	+3.9	-	4.9/5.1	2.21/2.26						
	9	95.3	-	+3.2	-	4.1/3.9	2.02/1.97						
	10	101.0	-	+3.2	-	3.9/4.4	1.97/2.10						
Average				+3.22			2.11	0.0734	6960.65	2121.63	0.85	1793.67	127.60

[a] Values estimated

[b] First value measured as pitot tube was inserted and second made as pitot tube was withdrawn.

TABLE G-5. AIRFLOW, HIGHEST--AKRON

Date: 4/10/80	Point	Traverse location (cm)	Total pressure Inlet Δ_h (in H_2O)	Total pressure Outlet Δ_h (in H_2O)	Pressure drop (in H_2O)	Velocity pressure inlet Δ_{hi} (in H_2O)	$\sqrt{\Delta_{hi}}$	Air density ρ_A (lb/ft³)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m²)	Airflow rate (m³/min)	Airflow rate (Mg/h)
						Air Classifier Plenum							
Baro. press: 28.52 in Hg	1	5.1	0.00[a]	-	-	1.80	1.34						
T_D = (61°F)	2	10.2	0.00	-	-	2.25	1.50						
T_W = (56°F)	3	15.2	0.00	-	-	2.20	1.48						
	4	25.4	0.00	-	-	2.20	1.48						
	5	35.6	0.00	-	-	2.35	1.53						
	6	45.7	0.00	-	-	2.20	1.48						
Average							1.47	0.0732	4875.03	1485.93	1.23	1820.84	128.18
						Air Classifier Heavies Chute							
	1	7.6											
	2	15.2				Values not measured							
	3	22.9											
						Material Handling Duct							
Baro. press: 28.50 in Hg	1	2.7	-		-	3.25/3.3[b]	1.80/1.82						
T_D = (61°F)	2	8.5	-		-	4.20/5.00	2.05/2.24						
T_W = (56°F)	3	15.4	-		-	4.60/5.70	2.14/2.39						
	4	23.4	-		-	5.20/5.20	2.28/2.28						
	5	35.5	-		-	4.80/4.70	2.19/2.17						
	6	68.3	-		-	4.80/5.40	2.19/2.32						
	7	80.3	-		-	4.30/5.20	2.07/2.28						
	8	88.3	-		-	4.40/4.50	2.10/2.12						
	9	95.3	-		-	3.80/4.40	1.95/2.10						
	10	101.0	-		-	4.20/4.20	2.05/2.05						
Average				6.8			2.13	0.0744	7000.12	2133.66	0.85	1803.84	129.18

[a] Values estimated.

[b] First value measured as pitot tube was inserted and second made as pitot tube was withdrawn.

TABLE G-6. PARTICLE SIZE DISTRIBUTION--AKRON

		Lights			Heavies		
Run No.	Screen size (cm)	Total weight (g)	% Retained	Cumulative % passing	Total weight (g)	% Retained	Cumulative % passing
1	+10.16	264.71	13.1	86.9	283.98	11.3	88.7
	+5.08	436.36	21.7	65.2	1111.74	44.4	44.3
	+2.54	192.89	9.6	55.6	298.05	11.9	32.4
	+1.59	285.74	14.2	41.4	276.77	11.0	21.4
	+0.95	499.22	24.8	16.6	510.74	20.5	0.9
	-0.95	334.31	16.6		22.52	0.9	
	Total	2013.23			2503.53		
2	+10.16	181.40	9.3	90.7	440.98	20.1	79.9
	+5.08	317.91	16.3	74.4	861.10	39.2	40.7
	+2.54	144.32	7.4	67.0	310.72	14.1	26.6
	+1.59	212.44	10.9	56.1	222.25	10.1	16.5
	+0.95	582.24	29.9	26.2	321.24	14.6	1.9
	-0.95	510.84	26.2		39.99	1.9	
	Total	1949.15			2196.28		
3	+10.16	171.33	9.3	90.7	109.96	6.1	93.9
	+5.08	400.50	21.6	69.1	597.21	33.3	60.6
	+2.54	212.84	11.5	57.6	174.05	9.8	50.8
	+1.59	297.11	16.1	41.5	220.89	12.3	38.5
	+0.95	449.49	24.3	17.2	506.25	28.3	10.2
	-0.95	318.65	17.2		182.64	10.2	
	Total	1850.52			1791.00		
6	+10.16	163.39	8.7	91.3	315.99	17.4	82.6
	+5.08	368.95	19.7	71.6	653.08	36.1	46.5
	+2.54	146.97	7.8	63.8	89.75	5.0	41.5
	+1.59	295.01	15.7	48.1	190.25	10.5	30.0
	+0.95	509.89	27.2	20.9	414.30	22.9	8.1
	-0.95	391.67	20.9		146.48	8.1	
	Total	1875.88			1809.85		

(continued)

TABLE G-6. (continued)

Run No.	Screen size (cm)	Lights: Total weight (g)	Lights: % Retained	Lights: Cumulative % passing	Heavies: Total weight (g)	Heavies: % Retained	Heavies: Cumulative % passing
7	+10.16	261.47	11.4	88.6	0.00	0	100
	+5.08	578.55	25.2	63.4	148.93	87.5	12.5
	+2.54	99.72	4.3	59.1	11.50	6.8	5.7
	+1.59	205.30	9.0	50.1	6.46	3.8	1.9
	+0.95	515.12	22.5	27.6	1.18	0.7	1.2
	-0.95	633.17	27.6		1.99	1.2	
	Total	2293.33			170.06		
8	+10.16	140.37	6.2	93.8	46.82	1.9	98.1
	+5.08	346.53	15.2	78.6	408.04	16.7	81.4
	+2.54	165.39	7.3	71.3	166.23	6.8	74.6
	+1.59	344.49	15.1	56.2	326.60	13.4	61.2
	+0.95	688.92	30.3	25.9	1077.04	44.1	17.1
	-0.95	590.42	25.9		419.00	17.1	
	Total	2276.12			2443.73		
9	+10.16	248.80	16.2	83.8	722.38	56.2	43.8
	+5.08	331.88	21.5	62.3	325.53	25.3	18.5
	+2.54	86.83	5.6	56.7	104.66	8.1	10.4
	+1.59	146.51	9.5	47.2	40.23	3.1	7.3
	+0.95	296.37	19.3	27.9	89.63	7.1	0.2
	-0.95	429.11	27.9		2.99	0.2	
	Total	1539.50			1285.42		
10	+10.16	267.66	14.0	86.0	146.19	23.1	76.9
	+5.08	376.43	19.7	66.3	342.76	54.3	22.6
	+2.54	118.80	6.2	60.1	67.01	10.6	12.0
	+1.59	188.47	9.8	50.3	35.33	5.6	6.4
	+0.95	367.88	19.2	31.1	38.42	6.1	0.3
	-0.95	594.49	31.1		2.14	0.3	
	Total	1913.73			631.85		

(continued)

TABLE G-6. (continued)

Run No.	Screen size (cm)	Lights Total weight (g)	Lights % Retained	Lights Cumulative % passing	Heavies Total weight (g)	Heavies % Retained	Heavies Cumulative % passing
11	+10.16	52.57	2.5	97.5	395.52	21.9	78.1
	+5.08	374.39	17.8	79.7	885.86	49.0	29.1
	+2.54	250.82	11.9	67.8	170.08	9.4	19.7
	+1.59	391.17	18.6	49.2	113.09	6.3	13.4
	+0.95	601.80	28.8	20.4	232.33	12.9	0.5
	-0.95	428.20	20.4		9.74	0.5	
	Total	2098.95			1806.62		
12	+10.16	248.29	15.0	85.0	24.20	4.1	95.9
	+5.08	368.13	22.1	62.9	316.92	53.0	42.9
	+2.54	85.91	5.2	57.7	93.31	15.6	27.3
	+1.59	151.08	9.1	48.6	58.78	9.8	17.5
	+0.95	361.13	21.7	26.9	100.81	16.9	0.6
	-0.95	446.66	26.9		3.57	0.6	
	Total	1660.48			597.59		
13	+10.16	26.32	1.2	98.8	102.74	5.3	94.7
	+5.08	350.73	15.4	83.4	605.23	31.2	63.5
	+2.54	159.41	7.0	76.4	155.93	8.0	55.5
	+1.59	617.31	27.2	49.2	247.29	12.7	42.8
	+0.95	616.78	27.2	22.0	603.31	31.1	11.7
	-0.95	500.93	22.0		226.45	11.7	
	Total	2271.48			1940.95		
15	+10.16	133.94	7.7	82.3	105.01	19.2	80.8
	+5.08	315.64	18.2	74.1	244.20	44.6	36.2
	+2.54	156.15	9.0	65.1	71.77	13.1	23.1
	+1.59	159.97	9.2	55.9	69.80	12.7	10.4
	+0.95	315.05	18.1	37.8	54.55	10.0	0.4
	-0.95	655.53	37.8		2.25	0.4	
	Total	1736.28			547.58		

(continued)

TABLE G-6. (concluded)

		Lights			Heavies		
Run No.	Screen size (cm)	Total weight (g)	% Retained	Cumulative % passing	Total weight (g)	% Retained	Cumulative % passing
16	+10.16	234.06	11.7	88.3	449.18	18.3	81.7
	+5.08	461.24	23.1	65.2	655.74	26.8	54.9
	+2.54	183.77	9.2	56.0	314.80	12.8	42.1
	+1.59	243.90	12.2	43.8	319.10	13.0	29.1
	+0.95	455.76	22.8	21.0	644.07	26.3	2.8
	-0.95	420.32	21.0		68.66	2.8	
	Total	1999.05			2451.55		
17	+10.16	191.34	13.0	87	531.53	20.3	79.7
	+5.08	336.51	22.8	64.2	775.56	29.6	50.1
	+2.54	164.87	11.2	53.0	215.79	8.3	41.8
	+1.59	208.62	14.1	38.9	310.89	11.9	29.9
	+0.95	337.66	22.9	16.0	638.46	24.4	5.5
	-0.95	237.14	16.0		143.40	5.5	
	Total	1476.14			2615.63		
18	+10.16	496.95	23.6	76.4	214.57	20.4	79.6
	+5.08	464.52	22.1	54.3	645.65	61.4	18.2
	+2.54	113.92	5.4	48.9	87.58	8.3	9.9
	+1.59	179.40	8.5	40.4	58.54	5.6	4.3
	+0.95	460.83	21.9	18.5	43.17	4.1	0.2
	-0.95	387.83	18.5		2.35	0.2	
	Total	2103.55			1051.86		
19	+10.16	106.84	14.1	85.9			
	+5.08	304.48	40.3	45.6			
	+2.54	99.74	13.2	32.4			
	+1.59	68.06	9.0	23.4			
	+0.95	83.89	11.1	12.3			
	-0.95	92.87	12.3				
	Total	755.88					

TABLE G-7. SAMPLE COMPOSITION--AKRON

			Lights					Heavies				
Run No.	Air setting (m³/min)	Screen size (cm)	Paper + plastic wt (g)	Alum. wt (g)	Ferrous wt (g)	Other wt (g)	Total wt (g)	Paper + plastic wt (g)	Alum wt (g)	Ferrous wt (g)	Other wt(g)	Total wt(g)
1	[illegible]	+10.16	203.15	0.00	0.00	61.56	264.71	0.00	0.00	283.98	0.00	283.98
	[illegible]	+5.08	361.45	12.52	7.28	55.11	436.36	68.65	23.34	702.40	317.08	1111.47
	[illegible]	+2.54	160.05	0.00	0.00	32.84	192.89	7.83	30.00	86.16	174.06	298.05
	[illegible]	+1.59	247.70	6.42	0.00	31.62	285.74	9.74	1.34	8.97	256.72	276.77
	[illegible]	+0.95	405.11	1.70	0.00	92.41	499.22	4.93	0.91	36.96	467.94	510.74
	[illegible]	-0.95	0.00	0.00	0.00	334.31	334.31	0.00	0.00	0.00	22.52	22.52
		Total	1377.46	20.64	7.28	607.85	2013.23	91.15	55.59	1118.47	1238.32	2503.53
2	[illegible]	+10.16	129.34	0.00	0.00	52.06	181.40	33.40	82.71	203.95	120.92	440.98
	[illegible]	+5.08	229.14	3.20	15.67	69.90	317.91	20.10	348.21	231.86	260.93	861.10
	[illegible]	+2.54	114.42	2.08	0.00	27.82	144.32	13.70	1.05	48.19	247.78	310.72
	[illegible]	+1.59	172.44	1.17	0.00	38.83	212.44	17.94	0.28	73.12	130.91	222.25
	[illegible]	+0.95	333.20	0.00	0.00	249.04	582.24	11.51	5.85	22.62	281.26	321.24
	[illegible]	-0.95	0.00	0.00	0.00	510.84	510.84	0.00	0.00	0.00	39.99	39.99
		Total	978.54	6.45	15.67	948.49	1949.15	96.65	438.10	579.74	1081.79	2196.28
3	[illegible]	+10.16	158.88	0.00	0.00	12.43	171.31	36.06	0.00	63.22	10.68	109.96
	[illegible]	+5.08	365.66	0.00	0.00	34.84	400.50	112.52	97.81	327.59	59.29	597.21
	[illegible]	+2.54	175.16	0.00	0.00	37.68	212.84	69.53	10.16	59.32	35.04	174.05
	[illegible]	+1.59	253.56	0.00	0.00	44.15	297.71	131.77	0.94	3.97	84.21	220.89
	[illegible]	+0.95	343.89	0.76	0.00	104.84	449.49	213.25	1.00	43.50	248.50	506.25
	[illegible]	-0.95	0.00	0.00	0.00	318.65	318.65	0.00	0.00	0.00	182.64	182.64
		Total	1297.15	0.76	0.00	552.59	1850.50	563.13	109.91	497.60	620.36	1791.00
4	[illegible]	+10.16	93.61	0.00	2.03	67.75	163.39	67.27	0.00	0.00	248.72	315.99
	[illegible]	+5.08	259.18	0.00	0.00	109.77	368.95	104.50	30.42	353.22	164.94	653.08
	[illegible]	+2.54	121.85	3.97	0.00	21.15	146.97	33.10	1.55	19.91	35.19	89.75
	[illegible]	+1.59	256.69	1.01	0.00	37.31	295.01	82.65	4.68	34.36	68.56	190.25
	[illegible]	+0.95	315.67	1.16	0.00	193.06	509.89	105.35	1.70	0.00	307.25	414.30
	[illegible]	-0.95	0.00	0.00	0.00	391.67	391.67	0.00	0.00	0.00	146.48	146.48
	[illegible]	Total	1047.00	6.14	2.03	820.71	1875.88	392.87	38.35	407.49	971.14	1809.85

(continued)

TABLE G-7. (continued)

Run No.	Air setting (m^3/min)	Screen size (cm)	Lights: Paper + plastic wt (g)	Lights: Alum. wt (g)	Lights: Ferrous wt (g)	Lights: Other wt (g)	Lights: Total wt (g)	Heavies: Paper + plastic wt (g)	Heavies: Alum wt (g)	Heavies: Ferrous wt (g)	Heavies: Other wt(g)	Heavies: Total wt(g)
7	1721.75	+10.16	261.12	0.00	0.00	0.35	261.47	0.00	0.00	0.00	0.00	0.00
	1721.75	+5.08	549.69	5.54	0.00	23.32	578.55	0.00	0.00	148.93	0.00	148.93
	1721.75	+2.54	76.55	6.51	0.00	16.66	99.72	0.00	0.00	11.50	0.00	11.50
	1721.75	+1.59	159.92	2.61	0.00	42.77	205.30	0.10	0.00	0.00	6.36	6.46
	1721.75	+0.95	320.49	0.00	0.00	194.63	515.12	0.14	0.00	0.20	0.84	1.18
	1721.75	-0.95	0.00	0.00	0.00	633.17	633.17	0.00	0.00	0.00	1.99	1.99
		Total	1367.77	14.66	0.00	910.90	2293.33	0.24	0.00	160.63	9.19	170.06
8	1952.52	+10.16	140.24	0.00	0.00	0.13	140.37	46.82	0.00	0.00	0.00	46.82
	1952.52	+5.08	323.88	0.80	0.00	21.85	346.53	203.75	30.46	130.60	43.23	408.04
	1952.52	+2.54	153.89	0.00	0.00	11.50	165.39	80.65	19.60	16.98	49.00	166.23
	1952.52	+1.59	312.63	0.00	0.00	31.86	344.49	167.23	3.26	5.00	151.11	326.60
	1952.52	+0.95	493.75	5.47	0.00	189.70	688.92	396.10	0.00	0.00	680.94	1077.04
	1952.52	-0.95	0.00	0.00	0.00	590.42	590.42	0.00	0.00	0.00	419.00	419.00
		Total	1424.39	6.27	0.00	845.46	2276.12	894.55	53.32	152.58	1343.28	2443.73
9	1952.52	+10.16	211.73	0.00	0.00	37.07	248.80	1.00	0.00	330.32	391.06	722.38
	1952.52	+5.08	251.05	8.27	0.00	72.56	331.88	3.86	17.19	263.31	41.17	325.53
	1952.52	+2.54	57.52	0.00	14.17	15.14	86.83	0.08	52.84	19.40	32.34	104.66
	1952.52	+1.59	124.23	0.00	0.00	22.28	146.51	3.86	0.70	6.13	29.54	40.23
	1952.52	+0.95	155.08	0.00	0.00	141.29	296.37	0.37	0.97	11.02	77.27	89.63
	1952.52	-0.95	0.00	0.00	0.00	429.11	429.11	0.00	0.00	0.00	2.99	2.99
		Total	799.61	8.27	14.17	717.45	1539.50	9.17	71.70	630.18	574.37	1285.42
10	1952.52	+10.16	231.87	0.00	0.00	35.79	267.66	0.00	0.00	52.73	93.46	146.19
	1952.52	+5.08	291.04	3.77	11.65	69.97	376.43	7.38	28.62	214.02	92.74	342.76
	1952.52	+2.54	91.40	0.00	0.00	27.40	118.80	11.65	14.39	16.78	24.19	67.01
	1952.52	+1.59	166.40	0.00	2.75	19.32	188.47	0.90	0.00	15.62	18.81	35.33
	1952.52	+0.95	220.62	2.14	6.03	139.09	367.88	0.46	0.63	4.59	32.74	38.42
	1952.52	-0.95	0.00	0.00	0.00	594.49	594.49	0.00	0.00	0.00	2.14	2.14
		Total	1001.33	5.91	20.43	886.16	1913.73	20.39	43.64	303.74	264.08	631.85

(continued)

TABLE G-7. (continued)

Run No.	Air setting (m^3/min)	Screen size (cm)	Lights: Paper + plastic wt (g)	Lights: Alum. wt (g)	Lights: Ferrous wt (g)	Lights: Other wt (g)	Lights: Total wt (g)	Heavies: Paper + plastic wt (g)	Heavies: Alum wt (g)	Heavies: Ferrous wt (g)	Heavies: Other wt(g)	Heavies: Total wt(g)
[illegible]	[illegible]	+10.16	52.42	0.00	0.00	0.15	52.57	7.12	0.00	308.96	79.44	395.52
	[illegible]	+5.08	345.49	0.00	6.86	22.04	374.39	24.34	210.18	562.87	88.47	885.86
	[illegible]	+2.54	218.84	0.00	0.00	31.98	250.82	20.38	32.19	59.38	58.13	170.08
	[illegible]	+1.59	345.93	0.00	2.25	42.99	391.17	4.37	1.47	15.56	91.69	113.09
	[illegible]	+0.95	356.07	0.00	0.00	245.73	601.80	4.83	0.00	28.95	198.55	232.33
	[illegible]	-0.95	0.00	0.00	0.00	428.20	428.20	0.00	0.00	0.00	9.74	9.74
		Total	1318.75	0.00	9.11	771.09	2098.95	61.04	243.84	975.72	527.76	1806.62
[illegible]	[illegible]	+10.16	176.70	0.00	8.88	62.71	248.29	24.20	0.00	0.00	0.00	24.20
	[illegible]	+5.08	322.94	3.05	0.00	42.14	368.13	10.72	95.02	68.37	142.81	316.92
	[illegible]	+2.54	65.55	7.10	6.78	6.48	85.91	8.59	0.00	26.15	58.57	93.31
	[illegible]	+1.59	126.31	0.00	0.00	24.77	151.08	5.08	1.43	1.56	50.71	58.78
	[illegible]	+0.95	136.29	0.00	0.00	224.84	361.13	1.80	0.26	6.02	92.73	100.81
	[illegible]	-0.95	0.00	0.00	0.00	446.66	446.66	0.00	0.00	0.00	3.57	3.57
		Total	827.79	10.15	15.66	807.60	1660.20	50.39	96.71	102.10	348.39	597.59
[illegible]	[illegible]	+10.16	26.32	0.00	0.00	0.00	26.32	61.66	0.00	0.00	41.08	102.74
	[illegible]	+5.08	274.46	0.00	0.00	76.27	350.73	181.34	87.28	246.26	90.35	605.23
	[illegible]	+2.54	141.47	10.29	0.00	7.65	159.41	63.25	9.02	38.64	45.02	155.93
	[illegible]	+1.59	588.45	2.03	0.00	26.83	617.31	131.63	2.44	9.33	103.89	247.29
	[illegible]	+0.95	431.68	0.00	0.00	185.10	616.78	288.66	6.24	0.00	308.41	603.31
	[illegible]	-0.95	0.00	0.00	0.00	500.93	500.93	0.00	0.00	0.00	226.45	226.45
		Total	1462.38	12.32	0.00	796.78	2271.48	726.54	104.98	294.23	815.20	1940.95
[illegible]	[illegible]	+10.16	94.67	0.00	35.83	3.44	133.94	0.00	0.00	63.00	42.01	105.01
	[illegible]	+5.08	252.53	0.00	41.03	22.08	315.64	0.00	0.00	154.82	89.38	244.20
	[illegible]	+2.54	123.77	3.68	0.00	28.70	156.15	2.67	0.00	14.73	54.37	71.77
	[illegible]	+1.59	105.04	9.00	0.00	45.93	159.97	4.62	2.39	0.00	62.79	69.80
	[illegible]	+0.95	64.40	1.67	0.00	248.93	315.05	0.43	5.87	4.37	43.88	54.55
		-0.95	0.00	0.00	0.00	655.53	655.53	0.00	0.00	0.00	2.25	2.25
		Total	640.41	16.35	76.86	1004.61	1736.28	7.72	8.26	236.92	294.68	547.58

(continued)

TABLE G-7. (concluded)

			Lights					Heavies				
Run No.	Air setting (m³/min)	Screen size (cm)	Paper + plastic wt (g)	Alum. wt (g)	Ferrous wt (g)	Other wt (g)	Total wt (g)	Paper + plastic wt (g)	Alum wt (g)	Ferrous wt (g)	Other wt(g)	Total wt(g)
16	1820.84	+10.16	225.07	0.00	6.23	2.76	234.06	36.18	0.00	208.40	204.60	449.18
	1820.84	+5.08	356.52	25.05	32.86	46.81	461.24	73.91	10.30	297.87	273.66	655.74
	1820.84	+2.54	145.20	0.00	8.58	29.99	183.77	31.40	24.88	127.12	131.40	314.80
	1820.84	+1.59	219.98	0.00	0.00	23.92	243.90	40.32	20.63	49.39	208.76	319.10
	1820.84	+0.95	306.38	0.00	0.00	149.38	455.76	59.38	0.00	68.68	516.01	644.07
	1820.84	-0.95	0.00	0.00	0.00	420.32	420.32	0.00	0.00	0.00	68.66	68.66
		Total	1253.15	25.05	47.67	673.18	1999.05	241.19	55.81	751.46	1403.09	2451.55
17	1820.84	+10.16	167.98	23.36	0.00	0.00	191.34	205.88	170.41	39.24	116.00	531.53
	1820.84	+5.08	329.52	0.04	0.00	6.95	336.51	367.62	62.20	202.43	143.31	775.56
	1820.84	+2.54	143.70	0.00	3.41	17.76	164.87	67.48	0.00	51.17	97.14	215.79
	1820.84	+1.59	193.11	0.00	0.00	15.51	208.62	184.08	3.17	4.80	118.84	310.89
	1820.84	+0.95	253.69	0.00	5.11	78.86	337.66	269.62	39.04	2.31	327.49	638.46
	1820.84	-0.95	0.00	0.00	0.00	237.14	237.14	0.00	0.00	0.00	143.40	143.40
		Total	1088.00	23.40	8.52	356.22	1476.14	1094.68	274.82	299.95	946.18	2615.63
18	1820.84	+10.16	476.91	0.00	17.32	2.72	496.95	0.00	0.00	214.57	0.00	214.57
	1820.84	+5.08	395.91	0.00	51.37	17.24	464.52	0.00	295.11	350.54	0.00	645.65
	1820.84	+2.54	84.30	0.00	0.00	29.62	113.92	3.99	0.00	71.76	11.83	87.58
	1820.84	+1.59	129.00	0.36	0.00	50.04	179.40	1.35	2.68	31.32	23.19	58.54
	1820.84	+0.95	143.25	0.69	0.59	316.40	460.93	0.05	0.00	10.76	32.36	43.17
	1820.84	-0.95	0.00	0.00	0.00	387.83	387.83	0.00	0.00	0.00	2.35	2.35
		Total	1229.37	1.05	69.28	803.85	2103.55	5.39	297.79	678.95	69.73	1051.86
19	1820.84	+10.16	101.45	0.00	0.00	5.39	106.84	0.00	0.00	0.00	0.00	0.00
	1820.84	+5.08	295.45	0.00	0.00	9.03	304.48	0.00	0.00	85.16	0.00	85.16
	1820.84	+2.54	89.39	0.00	0.00	10.35	99.74	0.00	0.00	0.00	0.00	0.00
	1820.84	+1.59	40.80	0.88	0.00	26.38	68.06	0.00	0.00	0.00	0.00	0.00
	1820.84	+0.95	30.09	1.64	0.00	52.16	83.89	0.06	0.00	2.92	1.12	4.04
	1820.84	-0.95	0.00	0.00	0.00	92.87	92.87	0.00	0.00	0.00	0.29	0.29
		Total	555.18	2.52	0.00	196.18	755.88	0.06	0.00	88.08	1.41	89.49

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TABLE G-8. MOISTURE CONTENT, INITIAL TO DRIED CONDITION--AKRON

Run no.	Lights: Initial wt (g)	Lights: Final wt (g)	Lights: Moisture wt (g)	Lights: Moisture Content %	Heavies: Initial wt (g)	Heavies: Final wt (g)	Heavies: Moisture wt (g)	Heavies: Moisture Content %
1	2582.13	2113.90	468.23	18.13	2724.00	2511.19	212.81	7.81
2	2468.63	1957.88	510.75	20.69	2355.13	2199.06	156.07	6.63
3	2298.38	1844.40	453.98	19.75	2213.25	1830.17	383.08	17.31
6	2440.25	1910.13	530.12	21.72	2227.44	1830.19	397.25	17.83
7	2752.38	2298.38	454.00	16.49	170.25	170.25	0.00	0.00
8	2823.31	2284.19	539.12	19.10	2951.00	2241.63	709.37	24.04
9	1957.88	1560.63	397.25	20.31	1404.56	1305.25	99.31	7.07
10	2298.38	1943.69	354.69	15.43	681.00	638.44	42.56	6.25
11	2638.88	2113.94	524.94	19.89	2014.63	1816.00	198.63	9.86
12	2099.75	1674.13	425.62	20.27	709.38	595.88	113.50	16.00
13	2837.50	2199.06	638.44	22.50	2468.63	2014.63	454.00	18.39
15	2170.69	1759.25	411.44	18.95	737.75	567.50	170.25	23.08
16	2468.63	2014.63	454.00	18.39	2738.19	2411.88	326.31	11.92
17	1844.40	1489.69	354.71	19.23	3050.31	2525.38	524.93	17.21
18	2610.50	2142.31	468.19	17.93	1078.25	1049.88	28.37	2.63
19	851.25	766.13	85.12	10.00	99.31	85.13	14.18	14.28

Sample Calculation: Moisture Content - initial to air-dried condition

$$\text{Percent Moisture Content} = \frac{\text{Initial Weight - Final Weight}}{\text{Initial Weight}} \times 100$$

$$\text{For Run No. 1 Lights} = \frac{2582.13 - 2113.90}{2582.13} \times 100 = 18.13\%$$

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TABLE G-9. POWER MEASUREMENTS--AKRON

Airflow Setting	Material Blower kW	Return Air Blower kW	Fluidizing Fans kW 2A	Fluidizing Fans kW 2B	Vibrator kW	Total kW
Lowest (15-in. air bleed opening)	137.1	103.1	7.6	29.1	7.2	284.1
Middle (5-in. air bleed opening)	138.4	103.1	11.1	23.0	7.2	282.8
Highest (0-in. air bleed opening)	138.1	103.1	11.2	23.1	7.2	282.7

APPENDIX H

FIELD TEST DATA FOR VIBRATING FLUIDIZED BED AIR CLASSIFIER--POMPANO BEACH, FLORIDA

TABLE H-1. SUMMARY OF OPERATIONAL DATA--POMPANO BEACH

Run No.	Input feed rate (Mg/h)	Lights feed rate (Mg/h)	Split percent lights	Air setting (m³/min)	Ash percent in lights	Ash percent in heavies	Paper + plastic percent in lights	Air Dry Moisture Air Dry % Moisture Lights	Air Dry Moisture Air Dry % Moisture Heavies	Paper + plastic percent in heavies	Higher heating Value, kJ/kg Lights	Higher heating Value, kJ/kg Heavies
1	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-		
2	[illegible]	[illegible]	[illegible]		-	-	-	-	-	-		
3	[illegible]	[illegible]	[illegible]		-	-	-	-	-	-		
4	[illegible]	[illegible]	[illegible]		-	-	-	-	-	-		
5	[illegible]	[illegible]	[illegible]		16.2	42.2	75.67	20.84	19.05	41.01	16,170	14,672
6	[illegible]	[illegible]	[illegible]		6.7	58.0	85.21	31.57	0.00	25.23	19,906	9,460
7	[illegible]	[illegible]	[illegible]		-	-	-	-	-	-		
8	[illegible]	[illegible]	[illegible]		11.6	26.6	79.51	17.07	16.67	65.45		
9	[illegible]	[illegible]	[illegible]		-	-	-	-	-	-		
10	[illegible]	[illegible]	[illegible]		8.9	13.9	86.02	5.71	18.37	75.66		
11	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-		
13	[illegible]	[illegible]	[illegible]		-	-	-	-	-	-		
14	[illegible]	[illegible]	[illegible]		7.4	13.8	88.99	10.00	16.00	79.97	18,236	17,696
15	[illegible]	[illegible]	[illegible]		10.3	12.0	78.50	15.00	19.05	79.11		
16	[illegible]	[illegible]	[illegible]		10.2	22.2	78.78	17.50	13.04	63.90		
17	[illegible]	[illegible]	[illegible]		-	-	-	-	-	-		
18	[illegible]	[illegible]	[illegible]		9.2	14.14	84.65	5.26	13.31	73.06	21,720	20,878
19	[illegible]	[illegible]	[illegible]		8.7	16.5	85.73	9.76	14.71	76.82		
20	[illegible]	[illegible]	[illegible]	[illegible]	17.3	16.7	78.8	12.20	10.02	67.92		
21	[illegible]	[illegible]	[illegible]		-	-	-	-	-	-		
22	[illegible]	[illegible]	[illegible]		7.6	17.8	92.7	9.68	10.71	70.74	21,861	20,176
23	[illegible]	[illegible]	[illegible]		11.1	26.7	88.4	8.33	14.29	50.72	20,036	16,989
24	[illegible]	[illegible]	[illegible]		-	-	-	-	-	-		
25	[illegible]	[illegible]	[illegible]		8.10	19.4	90.8	7.16	16.28	68.63	21,611	17,743
26	[illegible]	[illegible]	[illegible]		7.5	16.3	56.2	0.00	6.66	79.07	21,069	19,559
27	[illegible]	[illegible]	[illegible]		-	-	-	-	-	-		
28	[illegible]	[illegible]	[illegible]		11.9	20.0	90.43	8.57	8.33	75.51		

a Run No. 12 omitted.
b Airflow rate through air classifier plenum.
c Oven dried basis.

TABLE H-2. FEED RATES--POMPANO BEACH

Date (1980)	Run No.	Lights Sample weight (kg)	Lights Tare weight (kg)	Lights Balance weight (kg)	Lights Time (s)	Lights Feed rate (Mg/h)	Heavies Sample weight (kg)	Heavies Tare weight (kg)	Heavies Balance weight (kg)	Heavies Time (s)	Heavies Feed rate (Mg/h)	Input Feed rate (Mg/h)
6-23	1	7.91	0.05	7.86	6.1	4.64	1.50	0.05	1.45	10.0	0.52	5.16
6-23	2	8.37	0.05	8.32	8.2	3.65	1.76	0.05	1.71	10.0	0.61	4.27
6-23	3	2.07	0.05	2.02	7.7	0.94	1.25	0.05	1.20	16.0	0.27	1.21
6-23	4	9.02	0.05	8.97	10.9	2.96	0.77	0.05	0.71	15.0	0.17	3.13
6-23	5	6.27	0.05	6.22	12.4	1.81	0.91	0.05	0.85	15.0	0.21	2.01
6-23	6	1.48	0.05	1.42	24.0	0.21	0.34	0.05	0.29	30.0	0.03	0.25
6-23	7	4.41	0.05	4.36	14.9	1.05	3.52	0.05	3.47	30.0	0.42	1.47
6-23	8	7.49	0.05	7.44	14.1	1.90	2.18	0.05	2.13	20.0	0.38	2.28
6-23	9	10.78	0.05	10.73	7.8	4.95	3.75	0.05	3.69	10.0	1.33	6.28
6-23	10*	4.03	0.05	3.98	5.6	2.56	11.55	0.11	11.44	5.0	8.24	10.79
6-23	12	7.29	0.05	7.24	31.9	0.82	0.85	0.05	0.80	10.0	0.29	1.10
6-23	13	5.59	0.05	5.54	13.4	1.49	1.50	0.05	1.45	20.0	0.26	1.75
6-23	14	4.93	0.05	4.88	21.9	0.80	1.14	0.05	1.08	30.0	0.13	0.93
6-23	15	9.79	0.05	9.74	11.4	3.07	5.22	0.05	5.17	10.0	1.86	4.93
6-23	16	4.82	0.05	4.77	14.6	1.18	1.28	0.05	1.22	30.0	0.15	1.32
6-23	17	8.25	0.05	8.20	9.8	3.01	3.92	0.05	3.86	20.0	0.70	3.71
6-23	18	5.36	0.05	5.31	16.0	1.19	0.85	0.05	0.80	25.0	0.11	1.31
6-23	19	3.43	0.05	3.38	4.5	2.70	5.48	0.05	5.42	5.0	3.90	6.61
6-23	20	7.23	0.05	7.18	9.0	2.87	3.18	0.05	3.12	15.0	0.75	3.62
6-23	21	5.02	0.05	4.97	9.9	1.81	2.58	0.05	2.53	20.0	0.46	2.26
6-23	22	3.86	0.05	3.81	24.0	0.57	0.45	0.05	0.40	30.0	0.05	0.62
6-23	23	5.02	0.05	4.97	19.8	0.90	1.11	0.05	1.05	30.0	0.13	1.03
6-23	24	2.55	0.05	2.50	39.2	0.23	0.45	0.05	0.40	45.0	0.03	0.26
6-23	25	4.88	0.05	4.83	13.4	1.30	0.85	0.05	0.80	20.0	0.14	1.44
6-23	26	2.01	0.05	1.96	3.2	2.21	2.61	0.05	2.56	5.0	1.84	4.05
6-23	27	2.83	0.05	2.78	4.1	2.44	3.01	0.05	2.95	5.0	2.13	4.57
6-23	28	3.66	0.05	3.61	5.2	2.50	4.31	0.05	4.26	5.0	3.07	5.56

* Run 11 voided.

TABLE H-3. LOWEST AIRFLOW--POMPANO BEACH

Date	Baro. Press. P_B in Hg	Traverse Point	Traverse Location (cm)	Total pressure inlet Δh (in H_2O)	Total pressure outlet Δh (in H_2O)	Pressure drop (in H_2O)	Velocity press. inlet* Δh_i (in H_2O)	$\sqrt{\Delta h_i}$	Air density ρ_A (lb/ft³)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m²)	Airflow rate (m³/min)	Airflow rate (Mg/h)
6-22-80				Duct Ahead of Induced Draft Blower										
	P_B=29.92	1	1.32	-19.04	0.00		2.6/3.0	1.61/1.73						
		2	6.17	-18.36	0.00		2.4/2.7	1.55/1.64						
	T_{db}=44°C(110°F)	3	7.62	-17.68	0.00		2.6/2.7	1.61/1.64						
		4	11.48	-17.68	0.00		2.7/2.9	1.64/1.70						
	T_{wb}=20.56°C(69°F)	5	17.37	-17.68	0.00		2.9/2.8	1.70/1.67						
		6	23.42	-17.68	0.00		3.4/3.4	1.84/1.84						
		7	39.32	-17.68	0.00		3.4/3.5	1.84/1.87						
		8	43.38	-17.68	0.00		3.3/3.6	1.82/1.90						
		9	46.63	-17.68	0.00		3.1/3.6	1.76/1.90						
		10	48.48	-17.68	0.00		2.9/2.9	1.70/1.70						
	Average			-17.884	0.00	-17.884		1.733	0.0718	6,078.97	1,852.89	0.20	374.05	25.83
6-23-80				Air Classifier (above separation zone)										
	P_B=29.80	1	3.80	0.00	-0.31		0.46/0.47	0.68/0.69						
		2	11.43	0.00	-0.41		0.52/0.54	0.72/0.74						
	T_{db}=26.11°C(79°F)	3	19.05	0.00	-0.415		0.46/0.45	0.68/0.67						
	T_{wb}=18.33°C(65°F)	4	26.67	0.00	-0.40		0.32/0.32	0.57/0.57						
	Average				-0.384	- 0.384		0.663	0.0742	2,181.58	664.95	0.372	247.10	17.65
6-23-80	P_B=29.80			Air Classifier (heavies chute)**										
		1	4.00	0.00	0.00		0.015/0.015	0.122/0.122						
	T_{db}=26.11°C(79°F)	2	16.61	0.00	0.00		0.015/0.010	0.122/0.10						
	T_{wb}=18.33°C(65°F)	3	24.33	0.00	0.00		0.015/0.015	0.122/0.122						
	Average					0.00		0.118	0.0743	388.33	118.36	0.356	42.12	3.01
6-23-80	P_B=29.80			Dust Control Duct										
		1	3.80	0.00	-10.8		0.09/0.10	0.30/0.316						
	T_{db}=26.11(79°F)	2	11.43	0.00	-10.8		0.07/0.05	0.265/0.224						
		3	19.05	0.00	-10.8		0.05/0.05	0.224/0.224						
	T_{wb}=18.33(65°F)	4	28.67	0.00	-10.8		0.04/0.03	0.20/0.173						
	Average				-10.8	-10.8		0.241	0.0742	793.89	241.98	0.089	21.58	1.54

* First value read when inserting pitot tube; second when withdrawing.

** Pitot tube inserted at top of heavies chute opening.

TABLE H-4. MIDDLE AIRFLOW--POMPANO BEACH

Date	Baro. Pressure: P, in Hg	Traverse Point	Traverse Location (cm)	Total pressure inlet Δh (in H₂O)	Total pressure outlet Δh (in H₂O)	Pressure drop (in H₂O)	Velocity press. inlet* Δh_i (in H₂O)	$\sqrt{\Delta h_i}$	Air density σ_A (lb/ft³)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m²)	Airflow rate (m³/min)	Airflow rate (Mg/h)
[illegible]				Duct Ahead of Induced Draft Blower										
	P_B=29.91	1	1.32	-19.04	0.00		3.2/3.2	1.79/1.79						
		2	4.17	-18.36	0.00		2.7/2.4	1.64/1.55						
	T_{db}=[illegible]	3	7.62	-17.68	0.00		2.5/2.6	1.58/1.61						
		4	11.68	-17.68	0.00		2.8/2.8	1.67/1.67						
	T_{wb}=[illegible]	5	17.37	-17.68	0.00		2.8/2.8	1.67/1.67						
		6	33.62	-17.68	0.00		3.2/3.2	1.79/1.79						
		7	39.32	-17.68	0.00		3.3/3.7	1.82/1.92						
		8	43.30	-17.68	0.00		3.2/3.6	1.79/1.90						
		9	46.63	-17.68	0.00		3.3/3.5	1.82/1.87						
		10	49.48	-17.68	0.00		2.9/2.8	1.70/1.67						
	Average			-17.884	0.00	-17.884		1.7355	0.0718	6,087.21	1,855.40	0.20	374.55	25.87
[illegible]				Air Classifier (above separation zone)										
	P_B=29.88	1	3.8	0.00	-0.50		0.66/0.60	0.81/0.78						
		2	11.43	0.00	-0.675		0.66/0.71	0.81/0.84						
	T_{db}=[illegible]	3	19.05	0.00	-0.665		0.63/0.61	0.79/0.78						
	T_{wb}=[illegible]	4	26.67	0.00	-0.640		0.46/0.45	0.68/0.67						
	Average				-0.62	- 0.62		0.77	0.0742	2,538.99	773.71	0.372	287.52	20.52
[illegible]	P_B=29.88			Air Classifier (heavies chute)**										
		1	4.80	0.00	0.00		0.020/0.020	0.141/0.141						
	T_{db}=[illegible]	2	14.61	0.00	0.00		0.015/0.015	0.122/0.122						
	T_{wb}=[illegible]	3	24.33	0.00	0.00		0.015/0.020	0.122/0.141						
	Average				0.00	0.00		0.1315	0.0743	432.75	131.90	0.356	46. 93	3.36
[illegible]	P_B=29.88			Dust Control Duct										
		1	3.8	0.00	-10.8		0.08/0.12	0.283/0.346						
	T_{db}=[illegible]	2	11.43	0.00	-10.8		0.07/0.04	0.265/0.20						
		3	19.05	0.00	-10.8		0.04/0.03	0.20/0.173						
	T_{wb}=[illegible]	4	26.67	0.00	-10.8		0.03/0.03	0.173/0.173						
	Average				-10.8	-10.8		0.227	0.0742	747.77	227.92		20.30	1.45

* First value read when inserting pitot tube; second when withdrawing.
** Pitot tube inserted at top of heavies chute opening.

TABLE B-5. HIGHEST AIRFLOW--POMPANO BEACH

Date	Baro. Press: P, in Hg	Traverse Point	Traverse Location (cm)	Total pressure inlet Δh (in H_2O)	Total pressure outlet Δh (in H_2O)	Pressure drop (in H_2O)	Velocity press. inlet* Δh_v (in H_2O)	$\sqrt{\Delta h_v}$	Air density ρ_A (lb/ft³)	Air velocity (ft/min)	Air velocity (m/min)	Duct area (m²)	Airflow rate (m³/min)	Airflow rate (Mg/h)
6-22-80				Duct Ahead of Induced Draft Blower										
	P_B=29.92	1	1.52	-19.06	0.00		3.2/3.1	1.79/1.76						
		2	4.17	-18.36	0.00		2.7/2.4	1.64/1.55						
	T_{db}=[illegible]	3	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]						
		4	11.48	-17.68	0.00		2.6/2.9	1.61/1.70						
	T_{wb}=28.56°C(83°F)	5	17.37	-17.68	0.00		2.7/2.9	1.64/1.70						
		6	33.42	-17.68	0.00		3.2/3.5	1.79/1.87						
		7	39.32	-17.68	0.00		3.5/3.4	1.87/1.84						
		8	43.30	-17.68	0.00		3.2/3.5	1.79/1.87						
		9	46.63	-17.68	0.00		3.1/3.0	1.76/1.73						
		10	49.48	-17.68	0.00		2.6/2.5	1.61/1.58						
	Average			-17.884	0.00	-17.884		1.713	0.0718	6,008.29	1,831.35	0.20	369.69	25.54
6-23-80	P_B=29.88			Air Classifier (above separation zone)										
		1	3.80	0.00	-0.715		0.8/0.81	0.89/0.90						
	T_{db}=26.11°C(79°F)	2	11.43	0.00	-0.95		1.0/0.95	1.0/0.975						
		3	19.05	0.00	-0.90		0.98/0.90	0.99/0.949						
	T_{wb}=18.33°C(65°F)	4	26.67	0.00	-0.89		0.70/0.72	0.837/0.849						
	Average				-0.865	- 0.865		0.9275	0.742	3,055.44	931.24	0.372	346.10	24.69
6-23-80	P_B=29.88			Air Classifier (heavies chute)**										
		1	4.08	0.00	0.00		0.050/0.040	0.224/0.20						
	T_{db}=26.11°C(79°F)	2	14.61	0.00	0.00		0.040/0.030	0.20/0.173						
	T_{wb}=18.33°C(65°F)	3	24.33	0.00	0.00	0.00	0.040/0.040	0.20/0.20						
	Average							0.1995	0.0743	656.53	200.11	0.356	71.20	5.09
6-23-80	P_B=29.88			Dust Control Duct										
		1	3.80	0.00	-10.8		0.09/0.18	0.30/0.424						
	T_{db}=26.11°C(79°F)	2	11.43	0.00	-10.8		0.06/0.05	0.245/0.224						
		3	19.05	0.00	-10.8		0.04/0.04	0.20/0.20						
	T_{wb}=18.33°C(65°F)	4	26.67	0.00	-10.8		0.04/0.03	0.20/0.173						
	Average				-10.8	-10.8		0.2458	0.0742	809.70	246.80	0.089	21.98	1.57

* First value read when inserting pitot tube; second when withdrawing.

** Pitot tube inserted at top of heavies chute opening.

TABLE H-6. PARTICLE SIZE DISTRIBUTION--POMPANO BEACH

		Lights			Heavies		
Run No.	Screen size (cm)	Total weight (g)	% Retained	Cumulative % passing	Total weight (g)	% Retained	Cumulative % passing
5	+10.16	112.22	22.34	77.66	77.15	16.63	83.37
	+ 2.54	58.30	11.61	66.06	134.99	29.10	54.27
	+ 1.59	121.49	24.19	41.87	104.93	22.62	31.65
	+ 0.95	82.91	16.51	25.36	74.26	16.00	15.65
	+ 0.13	83.22	16.57	8.78	56.19	12.11	3.54
	- 0.13	44.16	8.79		16.44	3.54	
	Total	502.30			463.96		
6	+10.16	51.99	15.09	84.91	73.56	25.73	74.27
	+ 2.54	42.33	12.29	72.61	83.11	29.07	45.20
	+ 1.59	97.48	28.30	44.31	39.20	13.71	31.49
	+ 0.95	99.91	29.00	15.31	58.22	20.36	11.13
	+ 0.13	26.50	7.69	7.63	27.44	9.60	1.53
	- 0.13	26.25	7.62		4.37	1.53	
	Total	344.46			285.90		
8	+10.16	88.25	19.97	80.13	146.27	21.89	79.11
	+ 2.54	65.99	14.93	65.19	112.85	16.89	62.21
	+ 1.59	94.39	21.36	43.73	110.55	16.54	46.67
	+ 0.95	96.81	21.91	21.82	100.53	15.04	29.63
	+ 0.13	53.25	12.05	9.78	116.94	17.50	12.14
	- 0.13	43.19	9.77		81.08	12.13	
	Total	441.88			668.22		
10	+10.16	70.30	15.79	84.21	128.53	23.91	76.09
	+ 2.54	78.69	17.68	66.53	75.07	13.97	62.11
	+ 1.59	105.67	23.74	42.79	97.72	18.18	43.93
	+ 0.95	137.85	30.97	11.82	130.52	24.28	19.65
	+ 0.13	30.45	6.84	4.98	70.05	13.03	6.63
	- 0.13	22.18	4.98		35.56	6.62	
	Total	445.14			537.45		

(continued)

TABLE B-6. (continued)

Run No.	Screen size (cm)	Lights Total weight (g)	Lights % Retained	Lights Cumulative % passing	Heavies Total weight (g)	Heavies % Retained	Heavies Cumulative % passing
14	+10.16	51.51	23.03	77.97	121.81	21.90	78.11
	+ 2.54	30.43	13.01	64.96	103.43	18.60	59.51
	+ 1.59	54.47	23.30	41.66	145.37	26.14	33.37
	+ 0.95	65.90	28.18	13.48	113.72	20.45	12.92
	+ 0.13	17.27	7.39	6.09	47.98	8.63	4.28
	- 0.13	14.23	6.09		23.86	4.29	
	Total	233.81			556.17		
15	+10.16	128.40	28.62	71.38	120.41	27.05	72.95
	+ 2.54	18.75	4.18	67.19	36.77	8.26	64.68
	+ 1.59	77.91	17.36	49.83	61.49	13.81	50.87
	+ 0.95	89.28	19.90	29.93	99.64	22.38	28.49
	+ 0.13	69.05	15.39	14.55	70.75	15.89	12.61
	- 0.13	65.26	14.54		56.08	12.60	
	Total	448.65			445.14		
16	+10.16	83.41	19.07	80.93	91.71	16.84	83.16
	+ 2.54	63.15	14.44	66.49	133.55	24.52	58.63
	+ 1.59	99.61	22.78	43.71	138.17	25.37	33.26
	+ 0.95	110.77	25.33	18.38	104.66	19.22	14.04
	+ 0.13	46.68	10.67	7.71	60.42	11.10	2.95
	- 0.13	33.72	7.71		16.02	2.94	
	Total	437.34			554.53		
18	+10.16	109.64	23.41	76.59	79.26	19.42	80.58
	+ 2.54	60.65	12.95	63.64	70.45	17.26	63.32
	+ 1.59	107.34	22.92	40.72	119.07	29.18	34.14
	+ 0.95	113.80	24.30	16.42	90.14	22.09	12.05
	+ 0.13	41.01	8.76	7.66	34.58	8.47	3.58
	- 0.13	35.96	7.68		14.57	3.57	
	Total	468.40			408.07		

(continued)

TABLE B-6. (continued)

Run No.	Screen size (cm)	Lights: Total weight (g)	Lights: % Retained	Lights: Cumulative % passing	Heavies: Total weight (g)	Heavies: % Retained	Heavies: Cumulative % passing
19	+10.16	91.10	18.82	81.18	81.16	21.57	78.43
	+ 2.54	88.25	18.23	62.95	71.21	18.93	59.50
	+ 1.59	122.02	25.20	37.75	90.35	24.01	35.49
	+ 0.95	114.70	23.69	14.06	75.91	20.18	15.31
	+ 0.13	37.46	7.74	6.32	33.66	8.95	6.36
	- 0.13	30.61	6.32		23.95	6.36	
	Total	484.14			376.24		
20	+10.16	87.33	20.06	79.94	87.23	19.50	80.50
	+ 2.54	33.73	7.75	72.19	95.03	21.24	59.26
	+ 1.59	88.39	20.30	51.89	81.74	18.27	40.99
	+ 0.95	109.36	25.12	26.77	89.51	20.01	20.98
	+ 0.13	63.28	14.54	12.23	58.89	13.16	7.82
	- 0.13	53.22	12.22		34.93	7.81	
	Total	435.31			447.33		
22	+10.16	86.77	24.29	75.71	17.61	5.28	94.72
	+ 2.54	44.31	12.40	63.31	117.52	35.26	59.46
	+ 1.59	91.36	25.58	37.73	76.80	23.04	36.42
	+ 0.95	87.48	24.49	13.24	61.54	18.46	17.96
	+ 0.13	30.14	8.44	4.80	53.07	15.92	2.04
	- 0.13	17.16	4.80		6.73	2.02	
	Total	357.22			333.27		
23	+10.16	116.00	19.91	80.09	49.93	11.88	88.12
	+ 2.54	114.94	19.73	60.36	134.05	31.88	56.24
	+ 1.59	144.82	24.86	35.50	91.54	21.77	34.47
	+ 0.95	135.22	23.21	12.29	90.34	21.48	12.99
	+ 0.13	41.75	7.17	5.12	42.37	10.08	2.91
	- 0.13	29.86	5.12		12.23	2.91	
	Total	582.59			420.46		

(continued)

TABLE H-6. (concluded)

Run No.	Screen size (cm)	Lights: Total weight (g)	Lights: % Retained	Lights: Cumulative % passing	Heavies: Total weight (g)	Heavies: % Retained	Heavies: Cumulative % passing
25	+10.16	79.66	24.04	75.96	86.43	18.05	81.95
	+ 2.54	50.23	15.16	60.80	87.48	18.27	63.68
	+ 1.59	68.75	20.75	40.05	121.48	25.37	38.31
	+ 0.95	77.03	23.25	16.80	116.43	24.32	13.99
	+ 0.13	31.13	9.40	7.40	50.30	10.50	3.49
	- 0.13	24.54	7.41		16.68	3.48	
	Total	331.34			478.80		
26	+10.16	63.97	12.39	87.61	61.76	16.37	83.63
	+ 2.54	132.73	25.71	61.90	69.68	18.47	65.16
	+ 1.59	169.33	32.80	29.10	124.91	33.12	32.04
	+ 0.95	108.72	21.06	8.04	92.65	24.56	7.48
	+ 0.13	22.53	4.36	3.68	19.08	5.06	2.42
	- 0.13	18.90	3.66		9.10	2.41	
	Total	516.18			377.18		
28	+10.16	66.24	15.50	84.50	70.07	16.02	83.98
	+ 2.54	105.53	24.70	59.80	81.31	18.59	65.39
	+ 1.59	109.84	25.70	34.10	165.36	37.81	27.58
	+ 0.95	109.43	25.61	8.49	85.99	19.66	7.92
	+ 0.13	20.72	4.85	3.64	22.90	5.24	2.68
	- 0.13	15.56	3.64		11.76	2.69	
	Total	427.32			437.39		

TABLE H-7. SAMPLE COMPOSITION--POMPANO BEACH

		Lights						Heavies					
Run No.	Screen size (cm)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh* grit (g)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh* grit (g)
5	+10.16	102.76	2.89	0.00	6.57	112.22		41.04	6.71	9.83	19.57	77.15	
	+ 2.54	40.49	0.00	0.00	17.81	58.30		60.13	32.12	21.63	21.11	134.99	
	+ 1.59	92.60	3.12	5.19	20.58	121.49		37.18	28.45	9.91	29.39	104.93	
	+ 0.95	76.74	1.35	0.00	4.82	82.91		33.16	7.41	17.15	16.54	74.26	
	+ 0.13	67.49	1.82	0.13	13.78	83.22		18.75	1.03	11.75	24.66	56.19	
	- 0.13	0.00	0.00	0.00	44.16	44.16		0.00	0.00	0.00	16.44	16.44	
	Total	380.08	9.18	5.32	107.72	502.30	44.16	190.26	75.72	70.27	127.71	463.96	16.44
6	+10.16	48.04	0.48	0.00	3.47	51.99		5.12	2.49	52.70	13.25	73.56	
	+ 2.54	40.10	0.00	0.00	2.23	42.33		50.03	17.01	15.96	0.11	83.11	
	+ 1.59	94.41	0.00	0.00	3.07	97.48		9.59	9.15	0.00	20.46	39.20	
	+ 0.95	97.83	0.00	0.00	2.08	99.91		5.27	4.42	33.44	15.09	58.22	
	+ 0.13	13.15	0.63	0.00	12.72	26.50		2.13	1.04	6.12	18.15	27.44	
	- 0.13	0.00	0.00	0.00	26.25	26.25		6.00	0.00	0.00	4.37	4.37	
	Total	293.53	1.11	0.00	49.82	344.46	26.25	72.14	34.11	108.22	71.43	285.90	4.37
8	+10.16	86.15	0.23	0.00	1.87	88.25		124.16	1.80	2.71	17.60	146.27	
	+ 2.54	46.51	0.00	0.00	19.48	65.99		61.67	28.32	0.00	22.86	112.85	
	+ 1.59	78.55	1.58	0.00	14.26	94.39		83.17	2.70	8.39	16.29	110.55	
	+ 0.95	94.52	0.34	0.00	1.95	96.81		82.15	6.33	1.78	10.27	100.53	
	+ 0.13	45.60	0.14	0.00	7.51	53.25		86.19	0.46	0.00	30.29	116.94	
	- 0.13	0.00	0.00	0.00	43.19	43.19		0.00	0.00	0.00	81.08	81.08	
	Total	351.33	2.29	0.00	88.26	441.88	53.25	437.34	39.61	12.88	178.39	668.22	81.08
10	+10.16	65.98	0.78	0.00	3.54	70.30		115.71	1.68	4.23	6.91	128.53	
	+ 2.54	67.25	0.00	0.00	11.44	78.69		58.33	0.00	0.00	16.74	75.07	
	+ 1.59	97.11	3.20	0.00	5.36	105.67		85.19	6.81	0.00	5.72	97.72	
	+ 0.95	129.32	2.83	3.23	2.47	137.85		95.92	3.08	23.41	8.11	130.52	
	+ 0.13	23.27	0.15	0.15	6.88	30.45		51.47	1.28	0.11	17.19	70.05	
	- 0.13	0.00	0.00	0.00	22.18	22.18		0.00	0.00	0.00	35.56	35.56	
	Total	382.93	6.96	3.38	51.87	445.14	22.18	406.62	12.85	27.75	90.23	537.45	35.56

(continued)

TABLE H-7. (continued)

		Lights						Heavies					
Run No.	Screen size (cm)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh* grit (g)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh* grit (g)
14	+10.16	49.79	0.11	0.00	1.61	51.51		104.56	1.53	4.28	11.44	121.81	
	+ 2.54	30.41	0.00	0.00	0.02	30.43		63.32	8.91	0.00	31.20	103.43	
	+ 1.59	50.96	1.01	0.12	2.38	54.47		135.27	2.85	0.00	7.25	145.37	
	+ 0.95	63.30	1.53	0.00	1.07	65.90		103.14	3.82	0.00	6.76	113.72	
	+ 0.13	13.61	0.15	0.00	3.51	17.27		27.36	0.40	0.00	20.22	47.98	
	- 0.13	0.00	0.00	0.00	14.23	14.23		0.00	0.00	0.00	23.86	23.86	
	Total	208.07	2.80	0.12	22.83	233.81	14.23	433.65	17.51	4.28	100.73	556.17	23.86
15	+10.16	123.62	1.02	0.00	3.76	128.40		115.26	0.49	0.00	4.66	120.41	
	+ 2.54	18.75	0.00	0.00	0.00	18.75		35.25	0.00	0.00	1.52	36.77	
	+ 1.59	68.30	0.32	0.00	9.29	77.91		56.24	1.77	0.00	3.48	61.49	
	+ 0.95	85.15	1.68	0.00	2.45	89.28		94.97	1.90	0.00	2.77	99.64	
	+ 0.13	56.35	0.00	0.00	12.70	69.05		50.43	0.53	0.00	19.79	70.75	
	- 0.13	0.00	0.00	0.00	65.26	65.26		0.00	0.00	0.00	56.08	56.08	
	Total	352.17	3.02	0.00	93.46	448.65	65.26	325.15	4.69	0.00	88.30	445.14	56.08
16	+10.16	77.04	0.86	0.08	5.43	83.41		60.89	7.17	6.30	17.35	91.71	
	+ 2.54	36.05	0.00	0.00	27.10	63.15		86.19	33.80	0.00	13.56	133.55	
	+ 1.59	91.85	1.29	2.30	4.17	99.61		98.06	25.97	0.00	14.14	138.17	
	+ 0.95	106.08	1.56	0.00	3.13	110.77		75.92	8.01	4.42	16.31	104.66	
	+ 0.13	33.52	1.76	0.00	11.40	46.68		26.92	3.64	0.83	29.03	60.42	
	- 0.13	0.00	0.00	0.00	33.72	33.72		0.00	0.00	0.00	16.02	16.02	
	Total	344.54	5.47	2.38	84.95	437.34	33.72	347.98	78.59	11.55	106.41	544.53	16.02

(continued)

TABLE H-7. (continued)

		Lights						Heavies					
Run No.	Screen size (cm)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh* grit (g)	Paper and plastic weight (g)	Aluminum weight (g)	Ferrous weight (g)	Other weight (g)	Total weight (g)	14 Mesh* grit (g)
18	+10.16	105.70	0.55	0.00	3.39	109.64		67.94	2.75	1.11	7.46	79.26	
	+ 2.54	44.87	6.24	0.00	9.54	60.65		48.11	3.83	0.00	18.51	70.45	
	+ 1.59	99.78	0.00	0.00	7.56	107.34		80.37	7.69	8.19	22.82	119.07	
	+ 0.95	109.96	1.46	0.00	2.38	113.80		77.89	2.81	1.01	8.43	90.14	
	+ 0.13	36.21	0.25	0.00	4.55	41.01		23.81	1.42	0.00	9.35	34.58	
	- 0.13	0.00	0.00	0.00	35.96	35.96		0.00	0.00	0.00	14.57	14.57	
	Total	396.52	8.50	0.00	63.38	468.40	35.96	298.12	18.50	10.31	81.14	408.07	14.57
19	+10.16	86.73	1.82	0.00	2.55	91.10		73.50	3.91	0.00	3.75	81.16	
	+ 2.54	73.88	8.70	0.00	5.67	88.25		49.48	14.01	0.00	7.72	71.21	
	+ 1.59	116.61	0.36	0.00	5.05	122.02		74.96	0.65	11.41	3.33	90.35	
	+ 0.95	110.66	0.17	0.00	3.87	114.70		66.29	0.50	1.95	7.17	75.91	
	+ 0.13	27.18	0.67	0.29	9.32	37.46		24.78	0.32	0.00	8.56	33.66	
	- 0.13	0.00	0.00	0.00	30.61	30.61		0.00	0.00	0.00	23.95	23.95	
	Total	415.06	11.72	0.29	57.07	484.14	30.61	289.01	19.39	13.36	54.48	376.24	23.95
20	+10.16	82.05	0.24	0.34	4.7	87.33		73.42	2.18	1.25	10.38	87.23	
	+ 2.54	32.69	0.21	0.00	0.83	33.73		61.26	5.77	8.87	19.13	95.03	
	+ 1.59	72.58	2.95	2.49	10.37	88.39		62.88	2.27	5.25	11.34	81.74	
	+ 0.95	105.96	0.99	0.00	2.41	109.36		63.96	2.36	13.16	10.03	89.51	
	+ 0.13	49.76	0.48	0.00	13.04	63.28		42.31	0.89	5.52	10.17	58.89	
	-0.13	0.00	0.00	0.00	53.22	53.22		0.00	0.00	0.00	34.93	34.93	
	Total	343.04	4.87	2.83	84.57	435.31	53.22	303.83	13.47	34.05	95.98	447.33	34.93
22	+10.16	84.80	0.18	0.00	1.79	86.77		9.85	0.00	0.00	7.76	17.61	
	+ 2.54	27.53	0.00	0.00	16.78	44.31		83.30	0.67	26.67	6.88	117.52	
	+ 1.59	87.68	0.00	0.00	3.68	91.36		57.74	0.67	3.92	14.47	76.80	
	+ 0.95	85.30	0.00	0.00	2.18	87.48		47.56	4.73	3.70	5.55	61.54	
	+ 0.13	26.87	0.20	0.00	3.07	30.14		37.30	0.41	2.61	12.75	53.07	
	- 0.13	0.00	0.00	0.00	17.16	17.16		0.00	0.00	0.00	6.73	6.73	
	Total	312.18	0.38	0.00	44.66	357.22	17.16	235.75	6.48	36.90	54.14	333.27	6.73

(continued)

TABLE H-7. (concluded)

Run No.	Screen size (cm)	Lights: Paper and plastic weight (g)	Lights: Aluminum weight (g)	Lights: Ferrous weight (g)	Lights: Other weight (g)	Lights: Total weight (g)	Lights: 14 Mesh* grit (g)	Heavies: Paper and plastic weight (g)	Heavies: Aluminum weight (g)	Heavies: Ferrous weight (g)	Heavies: Other weight (g)	Heavies: Total weight (g)	Heavies: 14 Mesh* grit (g)
23	+10.16	109.87	1.92	0.00	4.21	116.00		24.14	1.80	8.90	15.09	49.93	
	+ 2.54	102.86	0.00	0.00	12.08	114.94		91.88	21.33	0.00	20.84	134.05	
	+ 1.59	138.57	1.49	0.00	4.76	144.82		46.40	1.17	24.07	19.90	91.54	
	+ 0.95	129.15	2.65	0.00	3.42	135.22		42.65	8.34	17.82	21.53	90.34	
	+ 0.13	32.99	0.74	0.00	8.02	41.75		8.19	2.18	5.37	26.63	42.37	
	- 0.13	0.00	0.00	0.00	29.86	29.86		0.00	0.00	0.00	12.23	12.23	
	Total	513.44	6.80	0.00	62.35	582.59	29.86	213.26	34.82	56.16	116.62	420.46	12.23
25	+10.16	76.53	0.21	0.00	2.92	79.66		60.45	3.74	2.69	19.55	86.43	
	+ 2.54	47.56	1.39	0.00	1.28	50.23		82.32	4.76	0.00	0.40	87.48	
	+ 1.59	65.58	0.70	0.00	2.47	68.75		77.55	10.91	14.37	18.65	121.48	
	+ 0.95	74.10	0.78	0.00	2.15	77.03		84.67	9.08	3.40	19.28	116.43	
	+ 0.13	27.74	0.06	0.00	3.33	31.13		23.61	2.07	2.07	22.55	50.30	
	- 0.13	0.00	0.00	0.00	24.54	24.54		0.00	0.00	0.00	16.68	16.68	
	Total	291.51	3.14	0.00	36.69	331.34	24.54	328.60	30.56	22.53	97.11	478.80	16.68
26	+10.16	57.82	3.15	0.00	3.00	63.97		48.43	1.19	5.41	6.73	61.76	
	+ 2.54	130.72	0.00	0.00	2.01	132.73		66.17	0.00	0.00	3.51	69.68	
	+ 1.59	166.72	0.90	0.00	2.16	169.33		99.33	4.93	13.97	6.68	124.91	
	+ 0.95	102.49	2.33	0.00	3.90	108.72		74.32	3.09	6.87	8.37	92.65	
	+ 0.13	16.17	0.33	0.00	6.03	22.53		10.00	0.35	1.11	7.62	19.08	
	- 0.13	0.00	0.00	0.00	18.90	18.90		0.00	0.00	0.00	9.10	9.10	
	Total	473.47	6.71	0.00	36.00	516.18	18.90	298.25	9.56	27.36	42.01	377.18	9.10
28	+10.16	64.08	0.28	0.00	1.88	66.24		59.49	2.08	3.22	5.28	70.07	
	+ 2.54	96.85	8.20	0.00	0.48	105.53		76.63	0.00	0.00	4.68	81.31	
	+ 1.59	103.38	3.23	0.00	3.23	109.84		99.80	19.98	36.37	9.21	165.36	
	+ 0.95	103.42	1.20	3.16	1.65	109.43		76.29	1.89	3.54	4.27	85.99	
	+ 0.13	18.69	0.13	0.00	1.90	20.72		18.08	0.66	0.00	4.16	22.90	
	- 0.13	0.00	0.00	0.00	15.56	15.56		0.00	0.00	0.00	11.76	11.76	
	Total	386.42	13.04	3.16	24.70	427.32	15.56	330.29	24.61	43.13	39.36	437.39	11.76

* Weight that passes 13 cm screen size is given here as 14 mesh grit.

TABLE H-8. MOISTURE CONTENT, INITIAL TO AIR DRY--POMPANO BEACH

	Lights				Heavies			
Run No.	Initial Weight (g)	Final Weight (g)	Moisture Weight (g)	Moisture Content (%)	Initial Weight (g)	Final Weight (g)	Moisture Weight (g)	Moisture Content (%)
5	681.00	539.12	141.88	20.83	595.88	482.38	113.50	19.05
6	397.25	383.06	13.94	3.51	312.12	312.12	0.00	0.04
8	581.69	482.38	99.31	17.07	851.25	709.38	141.87	16.67
10	496.56	468.19	28.37	5.71	695.19	567.50	127.69	18.37
14	283.75	255.38	28.37	10.00	709.38	595.88	113.50	16.00
15	567.50	482.38	85.12	15.00	595.88	482.38	113.50	19.05
16	567.50	468.19	99.31	17.50	652.62	567.50	85.12	13.04
18	539.12	510.75	28.37	5.26	524.94	454.00	70.94	13.51
19	581.69	524.94	56.75	9.76	482.38	411.44	70.94	14.71
20	581.69	510.75	70.94	12.20	567.60	510.75	56.85	10.02
22	439.81	397.25	42.56	9.68	397.25	354.69	42.56	10.71
23	681.00	624.25	56.75	8.33	496.56	425.62	70.94	14.29
25	397.25	368.88	28.37	7.14	610.06	510.75	99.31	16.28
26	567.60	567.60	0.00	0.00	425.62	397.25	28.37	6.67
28	496.56	454.00	42.56	8.57	510.75	468.19	42.56	8.33

TABLE H-9. POWER REQUIREMENTS--POMPANO BEACH

Air Setting	Energy (No Load) Main Blower kW	Fluidizing Blower kW	Cyclone Air Lock kW	Baghouse kW	Air Classifier Vibrator kW	Total kW
Low	35.8	5.95	1.32	2.92	3.13	49.12
Middle	35.6	5.93	1.32	2.92	3.13	48.90
High	35.8	5.95	1.32	2.92	3.13	49.12

LIST OF TERMS, ABBREVIATIONS, AND SYMBOLS

Terms	Definitions
Air classifier	- A system intended to separate refuse into light and heavy fractions using aerodynamic principles in a gravitational field.
Air classifier column area	- The cross-sectional area of the air classifier in the zone where lights and heavies separate, perpendicular to the airstream.
Air loading ratio	- The weight of infeed carried per unit weight of airflow.
Concentration factor	- Ratio of constituent percentage in a split stream to the constituent percentage in the infeed.
Critical column loading	- Weight of lights separated to the light fraction at transition point divided by the air classifier column cross-sectional area.
Heavy fracion	- That part of the infeed not carried away by the airstream in the air classifier.
Infeed	- Weight of material fed into the air classifier.
Light fraction	- That part of the infeed to an air classifier carried away by the airstream.
Light fraction combustibles	- The percentage of paper and plastic in the light fraction.
Light fraction separation transition point	- The solids to air weight ratio beyond which separation rate of lights declines with further increase of infeed rate. (Airflow rate constant.)
Light fraction split	- The percentage of air classifier feed materials reporting to the light fraction discharge (as-processed weight basis).
RDF	- Refuse-derived fuel.

Terms	Definitions
RDF yield	- Percentage of infeed separated as combustibles in the light fraction. Product of light fraction split and light fraction quality.
Solids/air ratio combustibles	- The as-processed mass flow rate of refuse by mass flow rate of air.
Specific energy	- The energy required by a unit or system and reported on an as-processed unit weight basis (kWh/Mg or kWh/ton).
Superficial column velocity	- The volumetric airflow through the separation zone divided by the air classifier column area.
A/S	- Air/solids weight ratio
Fe	- Ferrous metals
HF	- Heavy fraction
I/A	- Air loading ratio
IF	- Infeed
LF	- Light fraction
LFC	- Light fraction combustibles
Mg/h	- Megagrams per hour (1 ton = 0.9072 Mg)
NonFe	- Nonferrous metals
PP	- Paper and plastic (combustibles)
RDF-Y	- RDF yield
S/A	- Solids/air weight ratio